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Advisory Council on Coll. Chemistry.

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This supplementary report of the Committee on Curriculum and Advanced Courses of the Advisory Council on College Chemistry provides an analysis of problems in two-year college chemistry. It gives close attention to the transfer of students from junior colleges to full degree institutions. The course requirements necessary in junior college chemistry to ensure smooth transfer of students to the higher institution are examined. The four stated goals for effective articulation between institutions are (1) transfer students should not be forced to take additional courses at the higher institution, (2) a junior college transfer student should require the same number of credit hours to graduate as a student who completed bachelor's requirements in the senior institution, (3) junior college courses must fit the course requirements of the state college or university, and (4) colleges and campuses within an area should agree on lower division prerequisites for a major. Problems of the junior college transfer student particularly in California and Florida are discussed, and the present attitude of the American Chemical Society to these colleges is outlined. (GR)

ADVISORY COUNCIL ON COLLEGE CHEMISTRY

PROBLEMS IN TWO-YEAR COLLEGE CHEMISTRY

SUPPLEMENT

Publication No. 20A

SUPPLEMENTARY REPORT

PROBLEMS IN TWO-YEAR

COLLEGE CHEMISTRY

A supplement to a Report
prepared by the

COMMITTEE ON CURRICULUM AND

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of the

ADVISORY COUNCIL ON COLLEGE CHEMISTRY

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OF SUPPLEMENTARY REPORT

Advisory Council on College Chemistry
Suite 1124, 701 Welch Road
Palo Alto, California 94304

THE JUNIOR COLLEGE TRANSFER CURRICULUM AND THE FOUR-YEAR COLLEGES

by

W. T. MOONEY

Dr. Willard B. Spalding, Director of the State of California Coordinating Council for Higher Education recently stated:

"A prominent area of the Council's relations with junior colleges arises from the Master Plan goal of a statewide flow of students from high school to the bachelor's degree without interruption by artificial or capricious barrier to transfer from one seg ent to another or from institution to institution within a segment. As we all know, people are mobile. Therefore, junior college students living at home should not find themselves forced to complete additional courses when transferring either to another junior college or to a four-year college...if the goals of these students remain the same, they should be able to complete their college requirements with the same number of credit hours as if they had not transferred at all. Further, the Master Plan Survey Team believed that more students should complete their lower division programs in junior colleges. Members of the survey team, therefore, set a 1975 goal for the state colleges and the university of 60 percent of undergraduate enrollment in upper division and 40 percent in lower division... But diversion will not reach the size needed to produce the 60/40 ratio if students find that they cannot enter the upper divisions of state colleges or university campuses from junior colleges to which they had been diverted earlier.

"In addition, as state colleges and university campuses become filled, many eligible high school graduates will be unable to enter the college or campus of their first choice. Many who cannot afford to live away from home will enter junior colleges. After completion of lower division, if these students are then redirected to a remote college or campus, an untold number of college careers may be severely handicapped or even ended.

"And what about articulation? Many of those who can afford to attend college elsewhere after completing lower division requirements at a junior college will find that the work completed does not fit the requirements of the state college or university which they can attend. Through no fault of their own and as a direct result of the actions of a state college or a university campus, junior college transfer students have been required to complete more courses than they had anticipated. Here I refer to courses to meet prerequisites for majors, to meet breadth and general education requirements, or to meet both.

"The Council is concerned with these problems and will develop recommendations leading to their solution. Speaking personally, I am convinced that the best answers will be found when each segment accepts any other segment's judgments about what constitutes adequate general education in the lower division, and when all colleges and campuses within a segement agree upon lower division prerequisites for each major."

Goals of Articulation

Four ideas from Dr. Spalding's talk might well serve as benchmarks for our consideration of "The Junior College Transfer Curriculum and the Four-Year Colleges." These are:

1. Junior college students should not be forced to complete additional courses when transferring either to another junior college or a four-year college.

2. If the educational goal of the junior college student remains the same he should be able to complete his college requirements for the bachelor's degree with the same number of credit hours as if he had not transferred at all.
3. The work completed in the junior college must fit the requirements of the state college or university which the student will attend.
4. All of the colleges and campuses within a segment should agree upon lower division prerequisites for a major.

In order to bring these four ideas to fruition, several things must happen. Some will require changes and concessions on the part of the junior colleges; others, changes and concessions by the state colleges and the university campuses; and others, the commencement of some creative and cooperative coordination in the curriculum in chemistry and related fields among the three segments. Cooperation of the fourth sector of higher education, the private colleges and universities, in such coordination is also desirable.

The Open-door, Comprehensive, Community College in California

Before discussing the issues which stand in the way of realizing these goals and before suggesting action to get us on the road leading towards the realization of these objectives, I believe a brief description of California junior colleges is in order.

The 76 public junior colleges in California are characterized as open-door, comprehensive, community colleges. Of the 445,000 students enrolled in the fall semester of 1964 approximately 35 percent were full-time and 65 percent part-time. Last school year, 58 colleges responded to an inquiry concerning chemistry enrollment and listed 18,820 students enrolled in their chemistry courses in the fall. Forty-six colleges identified 1,050 majors.

What is an open-door, comprehensive, community college? The "open-door" means entry is unrestricted. Many courses and curricula are available, some within the range of the student's interests and abilities, some outside his interests, and some beyond his ability. He need not choose what lies outside his interest, but he should not be allowed to choose that which clearly lies beyond his ability. The open-door college does not mean the open-door curriculum. It presupposes a variety of curricula to match the potential of a variety of students.

The "comprehensive" means a multiplicity of educational functions or purposes. We subscribe to five: (1) education for occupational competence, (2) education for transfer to four-year colleges and universities, (3) general education, (4) guidance, and (5) community service.

The "community" concept arises because a college is locally governed, receives the majority of its financial support from local sources, is tuition free, and responds quickly to the educational needs of the community. With an extended day scheduling of classes, the evening enrollment may be larger than the day.

An understanding of each of these educational functions is important but further comment will be confined to education for transfer because that is essentially the topic of this paper.

Education for Transfer

Education for transfer includes providing a well-rounded lower division education for persons who desire to continue, beyond two years, their collegiate education in any of the academic or professional disciplines. Many students cannot qualify for the university or state college upon high school graduation but are capable of obtaining the bachelor's degree. We must provide an opportunity for them to demonstrate their capacity to maintain, over an extended period, an acceptable standard of scholarship in subjects of collegiate level, so that they can enter the four-year institution as fully qualified juniors. Many such "ineligibles" transfer, graduate from the university or state college and continue on to graduate work.

Many students eligible to enter either the university or state college upon high school graduation choose to attend their local junior college for their lower division studies. We must provide an opportunity for them to obtain an equivalent educational experience to that which their classmates, who entered the four-year college directly, receive. This experience must allow them to transfer as fully qualified juniors after four semesters at the junior college and allow them to pursue their upper division studies without prejudice or handicap so that they will be able to receive their bachelor's degree on schedule with their classmates.

To maintain college level standards in college level courses, some junior colleges provide remedial and high school equivalent courses for students who possess insufficient skill or competence for college level work.

Chemistry in the California Public Junior Colleges

A study of the 1965-66 catalogs of the 76 California public junior colleges has revealed certain common patterns among junior college chemistry programs.

General chemistry

Seventy-four colleges offer one year of general chemistry for ten semester units of credit (Chemistry 1A, 1B). These courses are generally scheduled for three lecture hours and two three-hour laboratory periods per week, two hours of which may be discussion or quiz. The prerequisite for the general chemistry courses vary from no previous chemistry required to one year of high school chemistry with an "A" or "B" grade. Validation of this experience may be required by means of a chemistry placement examination. Mathematical prerequisites range from none in some colleges to the completion of 3 1/2 years of high school mathematics including trigonometry in others. The second semester generally includes qualitative analysis in the laboratory.

Analytical chemistry

Sixty-eight colleges offer quantitative analysis. The predominant pattern is two hours lecture and discussion and six hours laboratory per week. Forty-two colleges grant four semester units and 26 give three semester units of credit. Sixty-five colleges require the completion of chemistry 1B prior to entering quantitative analysis. Eleven colleges offer a second semester of analytical chemistry which is either instrumental methods of analysis; advanced gravimetric, volumetric, and gas analysis; or a combination of both. Forty-three colleges include some instrumental work in their analytical chemistry program. One college, Pasadena City College, offers a combined one-year general chemistry and quantitative analysis course. Pasadena also offers a year of general chemistry and a one-semester quantitative analysis course.

Organic chemistry

Sixty-eight colleges offer organic chemistry. These courses tend to be directed to either chemistry and chemical engineering majors; or to be pre-medical, pre-dental, biological science and related majors; or to home economics, nursing, physical education and related majors. Twenty-two colleges offer an organic chemistry course primarily designed for chemistry majors. This course is generally designated Chemistry 12. Two colleges, City College of San Francisco and El Camino College, offer year courses while 20 colleges offer a one-semester course with laboratory. San Francisco gives ten units of credit, El Camino eight, San Mateo six and the other 19 colleges five. Twenty of these colleges offer at least one other organic course, which is generally designed for the pre-professional health science and biology majors.

Sixty colleges offer a survey of organic chemistry course for the pre-professional and biological science group. These courses are commonly designated Chemistry 8 or 9. Four colleges offer a year course with laboratory for this group. Glendale, Rio Hondo, San Diego City, San Diego Mesa, and El Camino College include these students with the chemistry

majors. Eight units are granted in four of these cases. Twenty colleges offer a one-semester course with laboratory, 13 for five units of credit and 14 for four units, and seven of the 14 allow the student to add a three-hour laboratory to the four-unit course and receive five units of credit. In all cases the five-unit courses require nine hours per week and the four-unit courses six hours.

Forty colleges offer a three-unit, three-lecture hour survey of organic course, Chemistry 8, and a separate laboratory course, Chemistry 9, requiring one or two hours lecture and discussion and six hours of laboratory and granting three units of credit. Four colleges offer the lecture course with no accompanying laboratory course.

Eleven colleges offer a three or four-unit course in organic and biochemistry for the home economics, nursing, etc. group. This is a two or three hours per week lecture and three hours per week laboratory course and is generally the second half of the non-science majors' chemistry course.

Physical chemistry

One college, the College of San Mateo, offers physical chemistry, a four-unit course, with three hours lecture and three hours laboratory, entitled Introduction to Physical Chemistry.

Chemistry for Non-Science Majors

Seventy-five colleges offer one or more chemistry courses for the non-science and non-engineering majors. Twenty-six offer a one-year course with laboratory, 49 a one-semester course with laboratory; and 15 a one-semester course with no laboratory. Fifteen colleges offer two different courses for these students.

The year courses vary in unit credit from three to nine and the one-semester courses from two to five. The year courses require from five to nine hours per week in class, the one-semester course with laboratory from five to ten hours, and the non-laboratory courses two to three hours. The most common patterns for the year courses are two semesters of four units, three hours lecture and three hours laboratory, found in eight colleges, and six units, two hours lecture and three hours laboratory, in 15 colleges. The most common patterns for the one-semester laboratory courses are three hours lecture and six hours laboratory for five units; four hours lecture and three hours laboratory for five units; and three hours lecture and three hours laboratory for four units.

Thirty-eight non-science major courses have no mathematical prerequisite, 33 require the completion of elementary algebra, and five the completion of plane geometry prior to enrollment. Six require the completion of a previous course in chemistry.

Beginning chemistry

Sixty-six colleges indicate specific courses which may be used to prepare students for Chemistry 1A, the first semester of general chemistry, if their background in chemistry is deficient. Thirty-four of these courses are designed primarily for this purpose and 43 courses are used for both the preparation for general chemistry and for the non-science major. Some colleges designate more than one such course.

In the beginning chemistry courses the unit spread is from zero to five units with an average of four. The hours required range from two to nine per week. Two colleges require the completion of intermediate algebra and five concurrent enrollment in intermediate algebra.

In the combined courses the units range from three to eight, the hours required range from three to 12, and only one college requires more mathematics than elementary algebra.

Twenty-three colleges do not require any mathematics to enter these courses.

Problems in Articulation

What are the problems which stand in the way of the realization of the four goals outlined earlier? Table 1 and Table 2 describe the chemistry curricula at five California State Colleges, four University of California campuses, and the University of Southern California. These present the picture of articulation problems in chemistry quite vividly. There are four

CHEMISTRY CURRICULA AT FOUR
UNIVERSITY OF CALIFORNIA CAMPUSES AND
THE UNIVERSITY OF SOUTHERN CALIFORNIA, PLANNED FOR 1966-67
As of January 1966

TABLE I

	University of California at Los Angeles	Semester[2] Units	University of California at Berkeley	Semester Units	University of California at Riverside	Semester Units	University of California at Santa Barbara	Semester Units	University of Southern California	Semester Units
General Chemistry	444[1]-444-444	8	264-264-264 or 365-365-365	(8) 10	334-334-334 365-365-365	(8) 10	334-334-334	8	444-444	8
Analytical Chemistry	In general & organic	-	264 or in general	(2.7)	365 in general	(3.3)	284	2.7	274	4
Organic Chemistry	444-444-444	8	365-365-365*	10	334*-334*-365*	8.7	344-344-344	8	374*-374*	8
Physical Chemistry	Junior Yr.	-	303	2	Junior Yr.	-	Junior Yr.		Junior Yr.	
Chemistry Total	16 units[2]		22 units[2]		18.7 units[2]		18.7 units[2]		20 units[2]	
Physics	10.7		12.3		10.7		12.7		8	
Mathematics	13.3		10.7		10.7		13.3		16	
German	10.7		8		Junior		8		12	
Others	9.3		7.0		13.3		11.3		8	
Total	60 units[2]		60 units[2]		54.4 units[2]		64 units[2]		64 units[2]	

*Upper division numbers. These courses are assigned upper division numbers rather than lower division numbers at these campuses and they therefore grant upper division credit for the course even though lower division students may enroll in the course.

[1] The notations 444, 365, etc. refer to the number of lecture and quiz hours per week, the number of laboratory hours per week, and the number of units of credit (quarter units for UC campuses and semester units for USC) as follows: 365 means 3 hours lecture or quiz, 6 hours laboratory, and 5 units of credit.

[2] For purposes of comparison all units have been changed to semester units in this column.

CHEMISTRY CURRICULA AT THE FIVE
LOS ANGELES COUNTY CAMPUSES OF THE CALIFORNIA
STATE COLLEGE SYSTEM PLANNED FOR 1966-1967
As of January 1966

TABLE II

	Long Beach	Semester Units	Los Angeles	Semester Units	San Fernando	Semester Units	Palos Verdes	Semester Units	Cal Poly	Semester Units
General Chemistry	[1] 365-365	10	365-365	10	365-365	10	404-264-264	8	334*-334*-264*	8
Analytical Chemistry	264	4	In general	--	264	4	In general	-	Senior year	-
Organic Chemistry	365*(365)	5	365*-365*	10	Junior year	--	466*-264*(264)	6.7	Junior year	-
Physical Chemistry	Junior year		Junior year		303	3	Junior year	-	Senior year Others	2.7
Chemistry Total	19 units[2]		20 units[2]		17 units[2]		14.7 units[2]		10.7 units[2]	
Physics	12		12		12		8		9.3	
Mathematics	16		15		16		8		12.7	
German	11		8		8		-		--	
Others	11		12		21		34		33.3	
Total	68 units[2]		67 units[2]		66 units[2]		64.[illegible] units[2]		66 units[2]	

*Upper division numbers - same as Table I.

[1] Same as Table I except Palos Verdes and Cal Poly are in quarter units.

[2] Same as Table 1.

major areas of concern related to the chemistry courses and four areas of concern related to courses outside chemistry. These are:

1. General chemistry. These problems are related to the mathematics and science prerequisites for general chemistry, to two different general chemistry programs for science majors being given in some colleges, to course content, to the amount of time devoted to the laboratory and to the lecture, and to the number of units of credit granted.
2. Analytical chemistry. These problems are related to whether or not analytical chemistry in the form of quantitative analysis is to be included as a separate course or spread throughout the general chemistry and possibly the organic chemistry program, to the amount of instrumentation included in the analytical chemistry courses, and to the credit granted for the analytical chemistry courses.
3. Organic chemistry. The problems here are many. They are related to the course content of the various organic courses; to the number of semesters or quarters required for various majors; to whether or not the course is given an upper division number or a lower division number; to whether or not it is required in the upper division or in the lower division; to whether or not the course is split between the upper division and the lower division; to the inability of the organic chemists to agree on how to split up the organic chemistry topics among the two semesters or three quarters; to the amount of laboratory hours required; to whether or not the chemistry majors and the pre-medical, pre-dental, biological science majors, etc. should take the same chemistry course or a different course; to how different these courses should be; and to the practice in which four-year college chemistry departments insist on evaluating year courses in organic chemistry from other institutions to determine if they will accept them rather than accept them on transfer as they do general chemistry.
4. Physical chemistry. This is the newest problem. It involves the offering of physical chemistry courses in the lower division and giving the courses lower division numbers and making them prerequisite to the upper division courses.
5. Physics. This involves how much of the physics sequence is required; how the topics of physics are divided and sequenced into the two, three, four or five courses which are required; and how much of the physics must be taken before physical chemistry.
6. Mathematics. This involves the level at which the college starts its college mathematics program; how many courses consitute the program; how many courses of the sequence are required; how the topics of mathematics are divided and sequenced into the three, four, five or six courses required; and how much of the mathematics must be taken before physical chemistry.
7. German. This involves how many units of foreign language are required, whether or not the number of units or the completion of scientific German is involved, and whether or not the student is expected to take the German in upper or lower divison.
8. Other courses. This involves the requirements for English composition and speech, for history and political science, for other social sciences and humanities, and for health and physical education. It also involves the requirements of the college for general education and how much of these are to be fulfilled in the lower division.

If one looks carefully at each of the two tables (page 5 and page 6), he sees the extent of the diversity of requirements and patterns in each of these eight areas in a sample of nine public and one private four-year institutions in California. When considering this sample one must remember there are 26 public and at least an equal number of private institutions in the state.

In addition to the problems in courses related to the chemistry major there are similar problems, perhaps less complex but equally important to the students and the junior college

chemistry faculty, associated with the general chemistry course for non-science majors; the survey course in organic chemistry for pre-medical, pre-dental, and biology majors; and the organic and biochemistry course for home economics, nursing, agriculture, and related majors. These courses and requirements also require the attention of any group or program setting out to improve articulation in chemistry between the two-year and the four-year colleges. To limit the scope of this paper a detailed consideration of these areas has not been attempted.

Suggestions for Coordination and Articulation of the Chemistry Programs of the California Junior Colleges, the California State Colleges and the University of California Campuses

What might be done to improve the coordination and articulation of the chemistry programs of the public institutions of higher education in California?

There are 12 things which could be done. Although some people may consider these to be a "blue sky" approach, we should place them on the table, begin to look to determine whether or not they are feasible, and evaluate the extent to which they might contribute to the improvement of the desired articulation and coordination. They should also contribute to the improvement of instruction in the various segments such as the junior colleges, state colleges and the University of California. These 12 suggestions are as follows:

1. Assign lower division numbers to all courses which are recommended and required for students enrolled as sophomores at the university and the state college campuses. Courses for which general chemistry is the only chemistry prerequisite should also be assigned lower division numbers.
2. Convene a committee on the articulation and coordination of the chemistry programs in the institutions of higher education in California and charge this committee to develop some guidelines for the chemistry major curricula and the freshman and sophomore year chemistry course offerings in these colleges. Such guidelines might include the following:
   a. Recommended patterns for courses in terms of hours and units;
   b. Recommended prerequisites for courses;
   c. Recommended equipment and instrumentation for such courses;
   d. Recommended minimum essentials for the content of such courses;
   e. Recommended library resources for both student and instructor use; and
   f. Recommended qualifications for faculty members assigned to teach these courses.
3. After the development of the guidelines in 2, all four-year colleges and universities should make any necessary revisions in their junior level courses to make sure that no more than that indicated in the guidelines is expected of students entering these courses and that students may complete their chemistry program in four semesters of work if they have met the requirements as set forth in the guidelines.
4. After the development of the guidelines in 2, all junior colleges and campuses of the four-year colleges should make any revisions necessary in their lower division chemistry programs to make sure that they meet these requirements.
5. All courses or sequences of courses that are certified as meeting the requirements of such guidelines should be mutually accepted by junior colleges, state colleges and university campuses when students transfer from one institution to another. It should be noted we have transfer problems when students transfer from the university or state college to the junior college and among the junior colleges as well as from the junior colleges to the four-year colleges.
6. Initiate a visiting scholar program in chemistry among the institutions of higher learning in California. Every junior college should have at least one visitor from a university campus and one from a state college campus each year. Such a program should attempt to get all faculty members of the four-year colleges concerned with

the undergraduate instructional program to serve as visitors. The visitors should be asked to give seminars, to counsel with faculty members and to counsel with students about transfer to the four-year institutions. Periodic conferences of such visitors should be held with junior college personnel to evaluate the visitor program and the chemistry programs of the junior colleges.

7. Initiate another visitation program in chemistry among the colleges in California whereby every junior college will send at least one chemistry faculty member to a university campus and one to a state college campus each year. Such visits should be for two to three days at a minimum. The visitor should consult with the faculty teaching both upper division and lower division courses at the four-year college, should observe lecture and laboratory sections, should confer with transfer students from his own college and from other junior colleges, and should give a seminar or discuss various aspects of chemistry in the junior college with the four-year college faculty.
8. Report from all colleges and campuses, both two-year and four-year, to transferring schools the courses and the grades received in such courses for students who have transferred into the chemistry program (curricula or sequence of courses) with such reports sent within the semester after the completion of the course. The transferring institution should be able to request continuing reports for succeeding semesters for any designated students.
9. Promote four-year college ACS Student Affiliate chapter assistance in the formation of local or regional chapters among junior colleges and establish a continuing program of cooperation in program planning and events among four-year college and two-year college Student Affiliate chapters.
10. Shift the four-year college emphasis on the granting of scholarships from freshmen students to junior college transfer students, thus enabling two students who have shown ability to do college level work to be favored in the awarding of scholarships instead of one new student who has not shown such ability. This program would have the effect of encouraging, rather than discouraging, students to attend junior colleges.
11. Establish a committee on research and teaching in the junior college to explore ways in which the universities and the state college campuses might assist the junior college faculties and students in the areas of chemistry teaching and chemical research. The purpose of such exploration would be to develop ways and means of developing limited but significant research programs for both faculty and students in the junior colleges.
12. Initiate a study and prepare a report on excellence in junior college chemistry programs as the American Institute of Physics and American Association of Physics Teachers have done for physics in the four-year colleges.

Additional Suggestions Resulting from the Conference

The 12 suggestions above were those presented by the author in the original conference paper. The deliberations of the conference suggested 22 additional suggestions, some of which are related to the original 12 but sufficiently different to mention below. The additional suggestions are as follows:

13. In connection with number 8 above, establish a central statistical reporting agency for the grade reports from four-year colleges for students transferring into the chemistry program from a two-year college. The central reporting agency would then report the student performance to the two-year college and could also make any necessary statistical studies. Such a program might be similar to that of the American Association of Medical Colleges.

14. Encourage four-year college chemistry faculties to invite representatives of the feeder two-year college chemistry faculties to attend meetings in which extensive discussion of radical curriculum changes are being considered and prior to adopting such changes.
15. Encourage four-year college chemistry faculties not to effect radical curriculum changes until the effect upon feeder two-year college programs has been given sufficient consideration, by both two-year and four-year college chemistry faculties, to insure a minimizing of transfer problems.
16. Request the four-year institutions to prepare course summaries for the information of the two-year colleges. Such summaries should indicate text(s) used, course coverage and major emphasis and need not be considered course outlines
17. Assign transfer students from two-year colleges entering the four-year college for a chemistry or a closely related major to a special advisor, preferably a senior staff member who has taken particular pains to become acquainted with the problems of the transfer student over a period of years.
18. Assign students in the junior college who declare their intention of majoring in chemistry or chemical engineering to members of the chemistry faculty for their academic advisement; preferably to staff members who have taken particular pains to become acquainted with the problems of the transfer student over a period of years. Grant such a faculty advisor some released time from his regular teaching load for advising so he may keep up to date with the many changes in the chemistry curricula and courses at the many four-year colleges to which his advisees will transfer.
19. Develop special topic instructional packages for those topics included as basic material in the lower division of some four-year institutions but not others. Through independent study, before transfer from the two-year college, students who are expected to have a knowledge and command of this information could prepare themselves for the junior level work expected upon transfer. Such packages should include a topical outline, recommended readings, typical problems and examination questions with an indication of the kinds of responses expected and the desired emphasis given the subject.
20. Encourage four-year colleges to hold off courses in physical chemistry and biochemistry until the junior year and to include a complete year course in organic chemistry in the sophomore year, and discourage two-year colleges from offering the physical and biochemistry courses.
21. Establish summer or academic year seminars in which two-year college faculty members could meet to review and discuss developments in given courses, text books available for such courses, laboratory materials, problems, and other resources for the courses. Faculty members of four-year colleges could be invited as either resource persons or as participants.
22. Develop internship or fellowship programs for both prospective and current two-year college chemistry faculty members. Such programs could be in connection with outstanding two-year colleges in conjunction with nearby four-year colleges.
23. Develop a handbook for articulation of the two-year and four-year college chemistry programs in a given state or region. Such a handbook should include curriculum and articulation information and ideas relevant to the chemistry program of both the two and four-year colleges of the state or region. It should also include guidelines and minimum standards for chemistry faculty, facilities and equipment for two-year college chemistry programs which are consistent with the faculty, facilities, and equipment standards of the four-year colleges in the state or region.
24. Adapt the "Minimum Standards" of the Committee on Professional Training of the American Chemical Society to the two-year colleges so they may be of assistance

to two-year colleges desiring to improve their chemistry programs but without becoming involved with the approval and listing of approved two-year college departments.

25. Encourage granting agencies to make small but significant research grants to qualified two-year college chemistry faculty members, and encourage the four-year institutions to make available significant summer research opportunities for two-year college faculty and students. (See also 11 above.)
26. Expand the articulation and coordination committee called for in 2 above into a continuing articulation conference for the state or region, and include private institutions if they are a significant part of the transfer picture in the state or region.
27. Initiate a study of two-year college chemistry transfer students and determine their success through the bachelor's and advanced degree levels such as was made for the Liberal Arts Colleges prior to the Wooster Conference. Use the study to determine those two-year colleges doing an outstanding job in the education of chemistry students and to determine common factors present in these institutions which might be correlated with outstanding programs.
28. Develop innovations in curriculum and instruction which would allow a two-year college to handle, within the framework structure of a single set of courses, several groups of students differing in majors and in intended transfer schools within a given major. Such ways might involve independent study courses for credit, out-of-class independent study within a course, special examinations, and special experiments.
29. Appoint a standing committee of the Advisory Council on College Chemistry to carry on a continuing investigation and attack on the problems of the chemistry departments of the two-year colleges. Establish liaison between this committee and similar groups of the other commissions and with the American Association of Junior Colleges.
30. Encourage four-year colleges not to accept students on the basis of the number of units completed alone, without evidence of the completion of the lower division requirement (course work) for the major with particular attention paid to the completion of the lower division year-course sequences in general chemistry, organic chemistry, physics, mathematics, and foreign language.
31. Establish a Committee of Visitors, which might include two representatives from two-year colleges, one from a state college and one from a university, who would visit, review, and discuss the chemistry curriculum and program with any given two-year college at its request.
32. Determine what it costs to operate a chemistry department in a two-year college at a level which will allow the junior college to put on a program comparable to that of the four-year institutions to which it will transfer students. (Related to 2 above.)
33. Initiate a program for developing chemical education leadership personnel for chemistry departments in the two-year colleges, such as the Kellogg Foundation has established for junior college administrators through the Junior College Leadership Program.
34. Establish some experimental articulation programs in areas where transfer is significant and increasing, and where the four-year institutions and the two-year institutions are willing to cooperate in an extensive study and action program.

I offer these 34 suggestions as a challenge to the Advisory Council on College Chemistry and to the Chemistry Departments of the institutions of higher education in California and other states having a significant number of two-year colleges. We need a program of

cooperative and creative coordination in the chemistry curricula in these institutions in California and other such states. Will we develop such a program? The program should be characterized by mutual respect among all parties concerned in all of the segments and also by a willingness to assist members of the other segments to solve the problems which stand in the way of improvement of articulation and coordination of the chemistry programs and of improvement of instruction in each of the institutions in the state.

Critique of W. T. Mooney's paper

THE JUNIOR COLLEGE TRANSFER CURRICULUM AND THE FOUR-YEAR COLLEGES

by

Robert B. Henderson

Mr. Mooney carefully and thoroughly describes the considerable problem facing the transfer students of chemistry in the California collegiate-level public education system. He quotes W. B. Spalding to delineate the Master Plan aim of full "interconvertibility" of academic "currency," and he proposes four goals we should seek for the benefit of the student. He moves from the general to the specific with summaries of structures of courses actually offered in community colleges in this state and presents the articulation problem in terms of the several courses customarily required of the chemistry major. Finally he proposes concrete suggestions.

Panel discussion of this admirable paper by Mr. Mooney followed generally the sequence outlined above. Probably the magnitude of the articulation problem is not fully appreciated by the state college or university faculties; certainly we at the California State College at Long Beach believed we were contending successfully with transfer student problems by individual interview and counselling programs. However, Mr. Mooney's facts, examples, and arguments are compelling.

A monolithic public education structure seems neither desirable nor possible. Clearly the trend is away from the previous degree of uniformity, and this aggravates the articulation problem, as Mr. Mooney points out. The day when the old University of California system (Chemistry 1A, 1B, 5 etc.) was the norm from border to border is passing. The University of California is installing next fall distinctly different curricula north and south. The proliferation of state colleges together with this system's doctrine of diversity with each campus developing to suit its own talents and regional needs inevitably are producing different scholastic patterns from one campus to another. There is no present prospect of the branches of the University reaching a common lower-division program; in the state college system, exploration of this possibility is scheduled but not begun. In short, the path to this goal is not presently discernible.

There is a danger sometimes of becoming too concerned with courses and units. Clearly, the education of the individual student is the real goal. Members of the Conference advanced the thesis that effective articulation is attained when the transfer student can graduate in the normal four years of full program work with substantially the same opportunity for elective courses as the non-transfer student. Precise uniformity of courses, requirements, and credit hours is not required. Hence we do not interpret Dr. Spalding's statement of the position of the California Coordinating Council completely literally.

Each segment of higher education in this state follows somewhat different practices and procedures for quite sufficient reasons. The junior colleges, as Mr. Mooney's summaries show, commonly offer beginning chemistry courses for those students not ready for the normal college-level general chemistry course; many require "C" or better grades before a student can move from one course to the next. The university, using extensive historical data on success of transfer students, sets a kind of double standard: a junior college student <u>who was eligible for university entrance upon graduation from high school</u> may transfer at any time with a grade-point average of 2.0 or better; others must have a minimum 2.4 average and transfer only at the junior level. The state colleges feel obligated to accept the transfer student in good standing at any level, but a major counselling effort is made to place the student in courses appropriate to his level of sophistication in chemistry. These practices are not haphazard or captious; they are designed in the light of experience to maximize the student's chances of success in college. We are not likely to "articulate" these practices out of existence or into uniformity.

Granted that variance will exist among programs of individual students, nevertheless the basic problem remains. How can the junior college student plan a program for transfer when disagreement exists among four-year schools regarding expected lower-division preparation? The first five of Mr. Mooney's suggestions are aimed at this specific point. Suggestion 1 dealing with course numbering is feasible and will probably automatically come about with the course renumbering required by conversion to the quarter system now underway by the state colleges and the university. Suggestions 2 through 5 call for convening a committee to prepare articulation recommendations and for the several segments of higher education to implement these recommendations both in the lower-division and upper-division courses. At present it seems extremely unlikely that these events will occur.

The next seven suggestions are aimed at the general improvement in chemical education in the public sector in California. Proposals involving visitations, exchanges of faculty, reporting of student histories, scholarship aid, Student Affiliate programs, research, and evaluation are made. Generally agreement exists that these are feasible and desirable steps - at least on an exploratory basis - provided implementation does not lead to an impression of "dictation" by one segment to another. Although it is not our present function to act concretely upon these suggestions of Mr. Mooney, we judge them to be valuable and urge action by the appropriate organization.

2.

THE JUNIOR COLLEGE TRANSFER AND THE STATE COLLEGES

by

David E. Clark

It would be presumptuous to attempt a state college view of the problem of junior college transfers. Only a personal view, arising out of some years of teaching, can be offered.

There are, as you know, 18 California State Colleges, stretching from San Diego State College in the south to Humboldt State College in the north. They vary in size from the new South Bay State College with but a handful of students to large, diversified, metropolitan institutions such as California State College at Los Angeles and San Jose State College. This system, the largest for higher education in the world, enrolled last year more than 150,000 students. Many of these students began their college careers in local junior colleges.

One of the recommendations of the Master Plan for Higher Education in California was that increasing numbers of students be urged to attend a junior college and transfer at a later date to a four-year institution. This diversion of students is to reach such proportions that the upper division in the state colleges will approach 60 percent of the total enrollment. Through transfer, the junior colleges will become the greatest source of upper division students.

This is also a time of great change, and, as the academic world moves, of rapid change. In our own field many colleges and universities are trying to break away from the traditional sequence of general, analytical, organic and physical chemistry. Within the newer pattern, there is less emphasis on the classical qualitative, gravimetric and volumetric analysis, and increased emphasis is placed on instrumental methods, preferably at an advanced level. Both elementary organic and physical chemistry are being moved forward in the major sequence, leaving the senior year free for advanced electives and independent research. At all levels, the presentation has become more theoretical and sophisticated.

To this healthy ferment and resulting modifications in curriculum, many of which are long overdue, there are other, more prosaic changes that may have a very immediate effect upon the problems of transfer. Entrance standards are going up at both the University of California and the California State Colleges in accordance with Master Plan recommendations to achieve by indirection the diversion of students to junior colleges. Over the next decade, both systems will convert all campuses to the quarter calendar. This conversion will require a complete restructuring of every course and every major within an institution. Old courses will disappear, to be replaced by new courses and new sequences. It will be a tragedy of lost opportunity if we fail to seize upon this enforced reorganization of the chemistry curriculum as a chance to modernize and improve and to re-examine our methods.

Currently, six of the state college campuses operate on a quarter calendar, but they represent only a very small part of the total enrollment. The turmoil of conversion for most of the colleges lies some years ahead. Perhaps future articulation conferences will intervene to assist in the inevitable problems of transfer arising from this conversion of calendar, and I shall not explore them further at this time.

Despite the massive reorganization facing the state colleges, one may predict that the outcome will be a conservative modification of existing programs. This does not mean that the changes will not be significant, and they will be clearly identifiable with those trends evident nationwide and to which reference has already been made. Whatever urge there may be towards true experimentation and innovation in curriculum is rapidly repressed by the realities we face. Increasingly, our students will be transfer students, coming not only from any one of the 74 public junior colleges in California but also from junior colleges outside the state. These students, by definition, step somewhere mid-stream into the chemistry major sequence. Quite clearly, such interesting and exciting programs as those at

Brown University or Amherst, to name only two, do not lend themselves to successful articulation by transfer students.

Most of us have participated in other conferences of this kind, and certainly this one will not be our last. College professors are by nature a gregarious type. Such mutual introspection and re-examination of courses and subject matter is beneficial. Quite properly, we are concerned with our students, for their success is our success. Yet I'm inclined to think that perhaps we worry too much about the problem of articulation, not because we shouldn't be concerned, but because to a very large degree the problems which do arise are not within our province to deal with directly.

Over the years, I have had the occasion to deal with many junior college transfers. In quality they have ranged from very good, and in some cases truly outstanding, to very poor. However, I would immediately say that our native, non-transfer students, even at the junior level, also display the same spectrum of academic ability.

If a student has in fact managed successfully two years of study at a junior college, one may assume that he has acquired some of the techniques of academic survival. If he does not possess mental agility, he must at least have tenacity. What then are the sources of future academic insolvency? The reasons are many and varied. Seldom, however, does the fundamental difficulty arise from a particular course sequence or content within a chemistry department which fails to articulate closely with a student's previous work.

Even at best the process of transfer is difficult. It obviously involves the strains of re-establishing personal and social relationships in an institution that may be much larger and less personalized. Rapport must be developed with new professors, a process that is not made less hazardous or difficult by professorial idiosyncrasies. It may frequently involve the first real break, not only from the restraint of the home, but also from the security which a home represents. All this comes at a time when academic competition intensifies and the level of achievement expected of the undergraduate is raised. Certainly students range widely in their ability to adjust, but the trauma is always there; it differs only in degree.

Any experienced teacher may add to this list of contributing difficulties: a lack of correspondence between interest and aptitude; poor motivation and lack of real commitment to a major field of study; insufficient preparation in supporting subject areas such as mathematics and physics; loss of units through non-transferable courses; a general lack of maturity and inability to assume responsibility; the demand of outside work and other obligations; the inability to withstand the added competition of upper division work. We should be surprised not that some fail but that so many do so well.

Occasionally a student will present himself for upper division work who obviously is lacking in the academic ability necessary to succeed in a science major. Perhaps this is a matter of some combination of luck. It may also raise questions about the existing regulations controlling transfer from a junior college into a four-year institution. At present, a student may transfer at the end of his second year with a "C" average even though he may not have been eligible for admission as a freshman. Since junior college admission is essentially unrestricted and the state colleges now admit only the upper one-third, the "C" average admission standard may be unrealistic. Entrance standards, being the product of statutes, are outside our jurisdiction, but certainly as teachers it is within our power, and I hope competence, to offer discerning and sympathetic advising to the students and to assist them in the pursuit of realistic goals which may or may not lie within a science department.

To suggest the above is not to overlook a degree of culpability on behalf of a chemistry department. To a student bedeviled by frustrations, disappointments, and distractions, pulled alternately by different subjects in as many different departments, a disjointed sequence of courses in a chosen major or severe subject matter gaps in his background may prove to be the straw that breaks the back. If, however, a student is capable and has tasted the rewards of real achievement, and if his motivation is genuine and his academic

work is sufficiently interesting and challenging to sustain his high expectations, he will successfully scale the hurdles that imperfect academic planning or lack of planning interpose.

While taking the position that the problems of articulation in course work are not as acute as sometimes represented, one may acknowledge that they do exist. All of us have the obligation to minimize, if we can't eliminate, wasted and duplicate effort on the part of both faculty and students. For the latter, the tensions and demands at best are sufficiently great such that we should not risk adding the last straw.

In some ways our task is made easier in the field of chemistry than in other areas. In general education, for example, a transfer student may arrive with a variety and hodgepodge of courses that may tax not only the ingenuity but also the credulity of transcript evaluators. The American Chemical Society, through the discipline of its standards established by its Committee on Professional Training and certification of graduating students, has exerted a restraining influence. It has prevented a proliferation of courses and the introduction of applied and technical courses of dubious value, and it has discouraged professional specialization at the undergraduate level. It has defined the proper areas of study and has suggested the appropriate amounts of time devoted to each in the chemistry major. Those schools on the Society's list of approved departments take pride in this recognition of quality, and most departments not on the list--and many excellent departments are not--attempt to tailor their programs to fit the Society's recommendations.

Except in those institutions attempting truly experimental programs, the first year of college chemistry remains predictable in content, constrained by tradition and the textbooks available. True, in the lecture hall, depending upon the institution and the instructor's inclination, it may have become more theoretically and physical-chemically oriented. Most instructors would agree that there is little time for descriptive chemistry that does not illustrate or serve as a base for theoretical principles. The chemistry of the blast furnace and baking powder has faded from the curriculum unredeemed by claims for its immediacy or intrinsic interest even to the terminal or non-major student.

It is with the sophomore year that serious questions arise concerning the most desirable sequence of courses for later transfer and articulation. The curriculum trends, mentioned briefly above, have compounded the problems. Simple arithmetic alone would indicate that even if it were desirable, there is not enough time available in two years for a student to take all of those courses that are now percolating downward and which, perhaps understandably, the junior colleges seem eager to incorporate into their programs. Certainly, it is not to the benefit of the student to load him down with chemistry if it delays his graduation from a junior college or prevents him from completing necessary work in mathematics, physics, and general education. If a student completes the equivalent of introductory chemistry and two additional semesters of chemistry, that is all that can be rightfully expected. A restraining decision must be made by the junior colleges which reflects honestly the limitations of time and facilities and, with candor and greater difficulty, the limitations of faculty.

What then is the best use that can be made of the two semesters of chemistry in the second year, in terms not only of articulation but also the student's personal growth? The prevailing pattern would seem to be one semester of quantitative analysis and one semester of organic chemistry. That such a combination is workable is readily proved by the records of many junior college transfers. That this sequence may be improved in the interests of better articulation hardly seems debatable.

Given the necessarily conservative nature of the chemistry curriculum in the state colleges and the fact that many courses play a service role to other departments and majors, the one-semester quantitative analysis course will be a part of the program for some time whatever its ultimate fate. Some agreement as to the proper unit value of this course would be of help.

It is with the one semester of organic chemistry that a substantive problem can arise, for this course does assume two different formats. It may be the commonly offered, self-contained rapid survey of the field, or it may be the less frequently encountered, truncated first half of a year's sequence dealing in greater depth with only a few of the topics normally treated in a full year's course. One of the courses, but not both, may mesh successfully with the year organic course in any given four-year institution.

My own inclination is to favor the far greater number of students who have come through the former type of course, the so-called Chem. 8. This has called for a significant change in the organization of the year's course as it is traditionally given. The first semester must become parallel to Chem. 8. The assumption is made, however, that the Chem. 8 is not merely a dreary and rote recitation of characteristic reactions by functional groups but has become a modern introduction to organic chemistry with proper attention given to structural theory, energetics, kinetics, and stereochemistry of organic processes. The second semester may then treat, in greater depth, theory and mechanism with added concern for the limitations and applications of the generalized reactions previously considered. Some repetition of subject matter is inevitable, and it may in part be beneficial. The repetition may be minimized, or at least disguised by changing from the function group approach in the first semester to a "reaction type" presentation in the second. To my knowledge, at the present time, no modern organic text is available with this sort of specific Part I and Part II arrangement.

What is attempted in the above scheme is a recognition of the organic chemistry a transfer student has received in junior college. A not infrequent alternative practiced by some four-year institutions is to require that the transfer student with one semester of introductory organic chemistry repeat, with or without credit, the first semester of the year course. Certainly, this represents an unnecessary waste and duplication of faculty and student time. It hardly gives encouragement to a junior college instructor to know that his best efforts are not recognized by the senior institution.

Of course, there is a second possibility, that of relinquishing to the junior colleges the responsibility of presenting the entire introductory year organic course. However, as long as the one-semester quantitative analysis course remains a recognized part of the lower division chemistry curriculum, the imposition of a full year of organic chemistry exceeds the desirable limits of time and units suggested above.

Much more important than the specifics of courses offered in the lower division is that whatever is taught must be well taught, thoroughly modern in its approach and scope, and reasonably demanding in terms of student performance and involvement. Continually, the student must be subject to critical evaluation such that grades reflect honest accomplishment. If so taught, a student will acquire a reservoir of fact, an understanding of principles, serious habits of study, and a growing maturity in chemistry that will insure his success regardless of the institution to which he may choose to transfer.

Critique of David E. Clark's paper

THE JUNIOR COLLEGE TRANSFER AND THE STATE COLLEGE

by

Thomas L. Jacobs

This excellent paper contains very little material which can serve as a basis for controversy. The complexities of California's system of higher education under the Master Plan for Higher Education in California have been presented clearly and the prospects for increasing numbers of transfer students have been emphasized. The problems faced by such transfer students are outlined.

It seems to me that a special problem which Professor Clark tends to minimize is that created for the chemistry major by the very cumulative nature of courses in the discipline. This is particularly evident in organic chemistry because most such transfer students have had an introductory course in the subject and must take at least one further course (usually more) which depends very directly upon the material already learned. The difficulty is increased by the rapid changes which have been made in the last decade or so with respect to the way organic chemistry is taught. Such changes are clearly apparent in the diversity of textbooks which one encounters.

Problems faced by the junior college transfer student are very much the same whether he is entering a California State College, the University of California or a private four-year university or college. Some differences exist in the level of competition encountered because admission standards vary. Specifically the state colleges can admit high school students who stand in the top third of their class, but the university accepts only those in the top 12 1/2 percent. Junior college students who were eligible for admission to the university but who chose (perhaps for financial reasons) to attend a junior college can transfer to the university at any time if their junior college grades in courses acceptable for transfer give them a "C" average. The same rule applies for transfer to state colleges. Experience has shown that these students on the average obtain grades as high as those earned by native students (i.e., students who take all of their work at the four-year institution). However, students who were not eligible for admission to the university must have 56 units of transfer courses with a grade point average of 2.4 or higher (on the basis of A=4, B=3, C=2, D=1, E and F=0) in units attempted. Experience has established that this higher grade point average is necessary to insure reasonable chance of success for the transfer student, and in fact the average would need to be 2.5 for the percentage of success to equal that of the native student. As Professor Clark indicated, transfer to state colleges is permitted after two years for students who have "C" averages in transferable courses even though they were ineligible to enter the state college directly from high school. For these students it would seem reasonable to require a somewhat higher average for transfer.

An important section of Professor Clark's paper discusses the diversity of course content and course organization in chemistry courses, especially organic, at different schools. Although, during the Conference, some people have expressed their belief in the desirability of greater uniformity in these matters, it is clearly unlikely that a change in this direction will or can be made. Teaching is an individual matter and the diversity of course content and organization reflects this individuality. Just as every good teacher accepts the prime responsibility to advance his students as far as he can toward mastery of the subject he is teaching, so he also insists on his right to do this in the way he thinks best and most effective. The best teaching requires this freedom to experiment, to change teaching methods and to select subject matter. Diversity is inevitable in a live, growing field such as chemistry. It should only be required that the teaching be effective as measured by student attainments.

It is my view that diversity in course content and organization is not a bar to success of transfer students. What is important is that the junior college course be comparable in

rigor with the corresponding course at the four-year institution. Emphasis must be on understanding the material and on the solving of problems. Organic chemistry should not be taught as a succession of reactions of different functional groups which are learned and simply repeated on examinations; it is important that the knowledge be applied in new situations in suitable problems. The student needs to learn to draw the best conclusions he can on the basis of his knowledge of the behavior of compounds. He should develop some sophistication in the subject and be unwilling to accept so-called facts or explanations without thought. The success that able transfer students enjoy is evidence that many junior college chemistry courses are comparable to the corresponding university courses and do attain these objectives.

In spite of the many successful transfer students, it would be unrealistic to minimize the difficulties which they encounter. This final section of the discussion will outline several ways which might be useful to make it easier for the transfer to be made.

One suggestion is for special advising for the transfer student when he arrives at the four-year school. Such advising should be done within the chemistry department for chemistry majors and should involve a discussion of the chemistry courses the student has already had and the course or courses he is about to take. Clearly the adviser needs to know a great deal about the content of the courses involved, especially if the student is entering midway in the organic chemistry sequence. Junior college teachers need to be aware that such advising is available (if it is) and to urge their transferring students to take advantage of it.

A second suggestion is that for organic chemistry, where transfer is to be made at some midway point, detailed information about the introductory organic chemistry course at the four-year school be available to the transfer student. Thus if a junior college student takes a one-semester course, lecture and laboratory in beginning organic chemistry, and then transfers to a campus of the university or a state college for the second semester of organic chemistry, he should be offered information about the first semester course the native students have had. This could be in the form of a set of examinations (best with answers), the name of the textbook and perhaps an outline of those parts of the textbook which were emphasized as well as simply covered. Information about laboratory work would also be helpful. In making this suggestion it should be emphasized that there is no intention to influence the course content or organization of the junior college course. Because students transfer from one junior college to a variety of different schools it is surely impossible for the junior college course to be tailored to any one four-year institution. The junior college teacher must enjoy the same freedom as the university teacher if he is to be effective. The important thing is to make information about the introductory course in the four-year school available to the transfer student. Junior college chemistry teachers should know when such information is available and should tell prospective transfer students. Advisers at the four-year school should be sure transfer students he advises know how to get it.

A third suggestion is that schedules at the university and state colleges be arranged so far as possible to permit a transfer student who encounters trouble in a given intermediate organic chemistry course to drop back to the preceding course if he finds it impossible to keep up. To some extent this has been possible at University of California at Los Angeles, but whether the tighter scheduling required under the quarter system will permit it is yet undetermined.

A fourth suggestion is that the professor teaching an intermediate organic chemistry class should make an attempt to provide background information to the transfer students. The kind of information mentioned above for the prerequisite course might now be supplied to transfer students. The kind of responses expected on examinations could be pointed out and the emphasis in the course explained. It might be possible to make separate periods available where the more unique parts of the prerequisite course were reviewed. Cer-

tainly the cumulative nature of organic chemistry should be emphasized for all of the students.

A final suggestion is that attempts be made to increase contact between professors in junior college chemistry departments and their counterparts in the four-year schools. This is an old suggestion but one that will always require new thought and effort. It is to be hoped that as the number of transfer students increases, the need for increased contacts will lead to imaginative ways of making such contacts more desirable to all.

3.

THE PRESENT ATTITUDE OF THE ACS TOWARD CHEMISTRY IN THE JUNIOR COLLEGES

by

Edward L. Haenisch

When I originally got this assignment I was under the impression that I was expected to make just a few remarks about what the Committee on Professional Training has done or has thought about with regard to junior colleges. Later it developed that I was expected to discuss the present attitude of the ACS towards chemistry in the junior colleges. To make sure that I would not misrepresent the Society I wrote Bob Silber, the membership secretary, and asked him to summarize for me what the Society was doing and what I could quote directly to this conference. In summary, one statement of Bob's letter is fairly significant as representing the attitude of the Society. I quote:

"I (Silber) could say in general that we are concerned about chemical education at the two-year post high school level and are ready to be helpful where we can."

Could you ask for better evidence that the Society is acutely conscious of junior coleges?

As you know, the Society established and holds biennial educational conferences. The last one was in 1964 and the next one will be this year. A large portion of both of these conferences will be or was devoted to topics pertinent to the junior college. Out of the '64 one came the step of allowing the establishment of Student Affiliate Chapters in junior colleges. There's no telling what will come out of the one that's coming this spring.

Specifically Bob has listed three other activities of the Society. As you know, there was an ad hoc committee to study technician training. It was chaired by Bill Young of UCLA, and two participants of this conference, Bill Mooney and Fred Schmitz, were members of the committee. The report of that committee is now in front of the Board. I will briefly summarize this report, but I feel rather foolish doing so with Bill and Fred here.

The committee made two suggestions. The first was that the Society develop a recommended set of objectives and courses which would be common to all chemical technology curricula nationally, and that the Society appoint a continuing advisory committee on the training of chemical technicians which would be responsible: (1) for keeping the recommended objectives and core courses in line with the changes in the requirements of industry brought about by new technological developments; and (2) for providing stimulants for and guidance to the organization and operation of a network of regional or local area committees. Secondly, they urged that chemical technicians be encouraged to join the Society. Another ad hoc committee, chaired by LeRoy Clemence, was appointed and is now studying membership in the Society on behalf of chemical technicians.

I'm sure you are aware also of the Junior College Round Table that Bill and some of you have had so much to do with. This has been largely an activity of the Division of Chemical Education. It is now receiving financial support from the Division.

Finally, Bob Silber asked me to mention the fact that now the "Academic Openings" publication contains junior college openings as well as senior college openings.

So I think there's no question but that the Society is concerned with the junior college and is in a position to open up and do something for you people if you make the proper demands and exert the proper push.

With those remarks, I'll not say anything more about the general attitude of the ACS toward junior colleges but to do what I feel more conversant with. I will talk briefly about the attitudes and what the Committee on Professional Training has had to say about junior colleges.

The "Minimum Standards" used to evaluate undergraduate education in chemistry have been continuously revised. The most recent edition came out in December 1965. It is available from John Howard, Secretary, Committee on Professional Training, 343 State Street, Rochester, N.Y., 14650. These standards, however, are essentially the 1962 standards with a few modifications.

We find ourselves in the face of what you've already heard here - experimental curricula that are highly significant. I think the Committee would find itself in a hard way to say that UCLA's new curriculum and its treatment of modern chemistry doesn't meet the spirit of the standards even though there are obvious discrepancies. Remember, please, I'm speaking only for one member of the Committee in what I just said. George Hammond is on the Committee. At Cal Tech they now have a second year course in chemistry called Covalent Chemistry which is supposed to cover inorganic, organic and everything else. So I don't think that anyone can say just where we now stand in chemical education, particularly with regard to the beginning courses. In setting up the new minimum standards we took the coward's position and talked more about what ought to be accomplished when the student is through at the Bachelor's level than what ought to be at the beginning.

It has occurred to me that one of the things that the Committee on Professional Training might do, which might be of benefit to the junior colleges, would be to prepare a statement such as the Appendix in the "Minimum Standards." I don't know how many of you know of the Appendix, but it is a statement concerning secondary school preparation. It was originally prepared by the Committee for vocational guidance pamphlet distributed by the American Chemical Society. The Appendix quite bluntly says that regardless of what branch of science, engineering or medicine the high school student may elect later to study in college, it is essential to take enough mathematics in high school. This will normally entail four years of college preparatory mathematics. It goes on to say, among other things, that a second year of chemistry shouldn't be taken if this means omitting physics and biology. It talks strongly about what language to study and ends up by saying that a prospective chemistry major should realize that if he enters college without the courses recommended, he may be unable in four years of collegiate training to attain the level which the Committee on Professional Training deems adequate for professional training at the Bachelor's degree and for entrance into graduate training in chemistry without further course work at the undergraduate level.

Since I gathered from some of the statements made yesterday that one of the articulation problems is not getting the proper amount of mathematics, language, and physics in the junior colleges, it seems to me that perhaps a statement by the Committee to junior college students on what would be the most important things they could do in a junior college in the general way of articulation might be a possibility for the Committee on Professional Training to consider. I do not know whether it would be worthwhile or not. I don't know that one could say what the preparation in chemistry ought to be. But there could be the emphasis, as is in the high school statement, on mathematics and the supporting items of language, English, and such. You might want to consider this idea and make recommendations of some sort to the Committee.

While I'm referring to language, I might point out one of the changes in the new minimum standards is that either German or Russian is required instead of just German as it has been. This change represents considerable blood, sweat, and tears on the part of the Committee members. There is, however, the proviso - and with this proviso I'm not sure that we've done much - if Russian is substituted for German, some use of Russian has to be made in the senior chemistry course, just as some use of German is now required.

I think that some of the "Minimum Standards" are of great significance to junior colleges. About four or five years ago at the request of some of the people in the junior colleges we included this statement; "To the extent that the 'Minimum Standards' are applicable, junior and community colleges should consider them in evaluating their chemistry programs for those students who will complete their undergraduate education at other institutions."

Significantly, then, if one turns to some of the statements under Faculty, I wonder how they would apply to the junior college people that are concerned with the transfer work. There are the problems of faculty degrees and teaching loads. The Standards now state that a mimimum of four full-time faculty members is essential. (This is going to cause some difficulty with a lot of the smaller liberal arts colleges.) For any staff at least 60 percent of the members of the senior faculty, instructors to professors, must have received an earned doctoral degree in chemistry. This is an increase over the previous requirement of a simple majority. Now comes perhaps the most significant statement: "Faculty members should have reasonable assignments. Research productivity and administrative and other academic duties should be considered in assigning teacher load. Under no circumstances should an individual faculty member have more than 15 contact hours (lecture contact hour - one fifty-minute period) per week including immediate supervision of laboratory work." (There are further statements concerning graduate school teaching loads that are not pertinent here.) Other applicable statements to junior college faculty members are: "Participation of faculty members and professional society activities is to be encouraged..., individual research productivity should be considered in appraising the quality of a member of the faculty." "The salary levels for each faculty rank should be sufficient to insure that well-trained and qualified personnel will accept faculty appointments and feel that there is an opportunity both professionally and financially for future growth."

From what I've heard at this conference about such institutions as Berkeley, UCLA, and others having roughly half of the graduating class chemistry majors from the two-year institutions, I am greatly concerned about the importance of the first two years in the training. The junior colleges are going to have to consider whether they can maintain salary levels to attract Ph.D.'s and support on-going research at their institutions. I don't know how possible this is. It is my own opinion that if the organic course is going to be taught in junior colleges at the level that organic chemistry is being treated now, it may be that Ph.D.'s are going to be required. I'm not saying that such a requirement has to be rigidly fulfilled but I think the Committee on Professional Training would be quite concerned in the four-year institution if the organic course weren't being given by a Ph.D. trained in organic chemistry.

I can't say anything at all about what ought to be in the first two years of chemical training, It's changing so fast. If you haven't read the particular publication of the Advisory Council, "The Content of Introductory College Chemistry," which is the summary of a conference that was held at Tulane just about two years ago, you ought to. The conference considered non-traditional topics in general chemistry and talked about such things as crystal structure, thermodynamics, kinetics, quantum chemistry and structure, one functional group, and quantitative analysis as a freshman chemistry topic.

The majority of institutions, as we know from what they report to the Committee on Professional Training, offer a year of general chemistry for the chemistry majors at fairly high level. The laboratory work includes the traditional classical quantitative analysis, some qualitative analysis, and some experiments that used to be in physical chemistry such as simple kinetics and energetics. This course is followed in a good many institutions by a year of organic chemistry. I gathered from what I heard here that this is not as common a pattern out here in California as it seems to be throughout the country.

I'd like to refer to a few other things from our "Minimum Standards." Please don't ask me necessarily to defend these. I can't. Things are changing too fast. All I can say is that the Committee right now has finally agreed that it's going to <u>try</u>, and may I underline "try" about 50 times, to state its minimum standards in terms of topics rather than the course structure. Whether it will succeed, I don't know, or whether in stating the topics, we could come to a place where we could say what are the topics that would be essential for the first two years. But we have agreed to come together in March with each Committee member to bring in his list. At that time the whole thing may blow up. But we're going to try, and we have promise of some support from the Advisory Council if this project seems to succeed.

There are two statements in "Minimum Standards" that I think most people forget about. In the description and prescription of a course in analytical chemistry, which must have at least one semester of physical chemistry as a prerequisite, there is the statement..."Earlier training in the fundamental techniques and theoretical background of classical quantitative analysis is presupposed." It is expected that such training will be included in no more than three semesters of introductory courses.

Under inorganic chemistry (which also has a physical chemistry prerequisite) there occurs the statement that ..."Earlier training in descriptive and synthetic inorganic chemistry and methods of separation of ions in aqueous solution is presupposed." The euphemism of "methods of separation of ions in aqueous solution" for qualitative analysis is important and is meant to be. We are not saying that the qualitative scheme ought to be touched but what one learns in the way of chemistry by studying equilibria and things of that sort still ought to be somewhere in the training of the chemist.

Here is what is said about organic chemistry. "The course should include synthetic methods and discussions of theories, especially reaction mechanisms. Some training in qualitative organic analysis by modern methods should be included either in the first course or in the advanced course." Again, from what I observe in reports to the Committee, a good deal of the qualitative organic is being put down into the first course. The first course also includes a lot on application of spectra, energetics and kinetics. Take a look at the Roberts and Caserio text.

Significantly in the new "Minimum Standards" we reduced the required amount of laboratory work in the undergraduate curriculum, which we say is roughly 390 hours <u>beyond</u> the introductory courses, i.e., the no more than three semesters of general and analytical. Of that 390, there has to be a minimum of 120 in organic. Until now, 180 were required. Again I can't defend these figures. They were sort of just pulled out of thin air and used.

Other than to say that the minimum standards are in a state of continued revision and turmoil the Committee's attitude is best expressed in saying that we want to see experimentation and flexibility. The overall program must provide the education prescribed.

This is where we are. I think I can say that we've argued a lot in the last few years as to whether we ought to legislate ourselves out of existence, and as to whether the maintenance of an approved list is any longer needed. I think a good many of the Committee feel that the major problem, as I mentioned last night, is the problem of the growth of graduate schools that aren't qualified to give the kind of a Ph.D. that has been traditional in chemistry.

The Committee's work load is becoming terrific. We tried to get out of part of it but were rather rebuffed in the meeting that we had in Atlantic City with the department heads. For the next few years, at least, we will maintain an approved list but with less checking than we have been able to do. In other words, I doubt that we can continue to get annual reports from the departments or make a visit once in every five years, which had been part of the original aim of the Committee. We are in a state of turmoil every time we talk about giving up the undergraduate program. We are reminded of what this Committee has been able to accomplish for the profession of chemistry since it was established. In spite of all the nasty remarks we get about our being a bunch of mean old men and how we're restraining the development of the chemical profession, we are going to continue, I guess, for awhile.

Critique of E. L. Haenisch's paper

THE PRESENT ATTITUDE OF THE ACS TOWARD CHEMISTRY

IN THE JUNIOR COLLEGES

by

Corwin Hansch

The report by Haenisch indicates that the American Chemical Society is beginning to concern itself more with the problems of chemistry in the two-year college. However, it is only recently that the vast dimensions of the problem are beginning to be clearly recognized by many of us who are not closely connected with the two-year colleges. In the California four-year colleges about 50 percent of the graduating chemistry majors are already two-year college transfers. Soon the two-year colleges will be teaching between 70 and 80 percent of the lower division students in California. If the rest of the country moves to this pattern, as seems very likely, chemistry instruction in the two-year colleges should become one of the primary concerns of the Advisory Council on College Chemistry as well as the American Chemical Society.

The conference brought out that the chemists in the two-year colleges are starving for some kind of leadership. Because of their local community base, because of the general lack of high professional status, and because of rather tight restrictions on their missing daily work to attend meetings, leaders in this group are few and far apart.

Time and again colleagues in the well-established universities are asked for advice on what to teach and what equipment must be introduced at the two-year level. A good part of this concern is, of course, with helping their students make the transfer as smoothly as possible. Instructors in the four-year schools have backed away from such demands.

Most of the discussion of the Haenisch report centered around the desirability and the possibility that the CPT or AC_3 might set up some minimum guidelines for junior college chemistry. It was brought out that at least for the present the same qualifications for four-year college faculty cannot be applied to two-year college faculty. Research expectations are absent in the two-year colleges so that more time can be spent on teaching; nevertheless, teaching loads must not be so heavy that instructors do not have the time and energy to keep up with the appalling pace of change in chemistry and its potential for changing chemical education. The leaders in the chemical profession must help their colleagues in the two-year colleges.

With the arrival of the very large two-year colleges (10,000 to 20,000 students), conditions are changing. There is no reason why such large, state supported institutions should not attract men with strong professional ambition and provide them with the opportunities to become leaders in certain phases of their profession. Some of these men will even want to make contributions through basic research.

Haenisch's suggestion that the CPT try to formulate an appendix to their present statement on "Minimum Standards" especially for the two-year colleges might be one step the American Chemical Society could take in providing better leadership for the community colleges.

4.

THE JUNIOR COLLEGE TRANSFER IN FLORIDA UNIVERSITIES

by

P. Calvin Maybury

The state of Florida finds itself facing the tremendous population explosion whch is now flooding the schools and colleges throughout the country. Florida junior colleges and universities enrolled 92,000 students in 1964-65. Because of the demand for college trained people and because of the rapid increase in the college age population, these enrollment figures are expected to double by 1970. Fortunately the leaders of the state of Florida began planning for the present student population increases 10 to 15 years ago.

A master plan for the state's educational system was prepared which involved building an integrated junior college-university system. Florida's junior college program has as its goal the providing of higher education within commuting distance of 99 out of every 100 residents of the state. With the planned opening of five new colleges next fall, this state will have the community colleges within reach of 85 percent of the population. Two additional junior colleges have received legislative approval and an additional junior college is being planned. These planned junior colleges plus the 20 now in operation will bring higher education near 99 percent of the population, according to Dr. James L. Wattenbarger, Director, Division of Community Junior Colleges, Florida State Department of Education. The figures do not include junior colleges for Negroes which are being phased out and consolidated with the new schools.

In January of 1963, Dr. Wattenbarger discussed with the Council of Presidents the need to articulate better the chemistry curricula of the public junior colleges and the universities. It was agreed that representatives of the junior colleges and representatives of the universities should get together to work out the understandings needed to serve as a basis for improved articulation. To insure effective use of the time of all concerned, seven representatives of the five state universities met to do some preliminary planning prior to meeting with the junior colleges.

The purpose of this meeting was to develop answers to the following questions so that a subsequent meeting with the junior college representatives could have the most beneficial results. (1) What are the competencies which are expected of students entering their third year of college chemistry? (2) What are the competencies which should be expected of students entering the study of chemistry in the first two years of college? (3) What are the minimum facilities which should be available when a college offers chemistry courses during the first two years after high school? (4) What are the competencies which a department head, dean, or president should look for in employing individuals to teach chemistry during the first two years of college? (5) What are the characteristics of general chemistry courses which could be used to serve the purposes of a variety of students who do not plan to continue beyond a first year college chemistry course?

Each state university prepared answers to the above five questions and this material was organized into a working paper for the further study of the committee. The final report then represented the operational position of the state university system of Florida on the topics involved for the coming meeting with representatives of all the public junior colleges. The final report, "Articulation of Chemistry Instruction in the Public Junior Colleges and the Institutions of the University System of Florida," was published on July 24, 1963 and a copy can be obtained by writing to the Division of Community Junior Colleges, State Department of Education, Tallahassee.

Briefly, the report contained the following information. The first part contained the recently revised requirements for a B.S. degree in chemistry as defined by the American Chemical Society Committee on Professional Training. Following this the remainder of the report addressed itself to the original five problems.

Under question 2, which is concerned with competencies expected of students entering their third year of college chemistry, a detailed list of course contents is presented for the one-year course in general chemistry, a one-semester chemistry course in analytical chemistry and a one-year course in organic chemistry. These do not represent course syllabi nor are they presented as course outlines, but they represent the minimum essential topics to be covered in acceptable courses of the types mentioned above.

Under problem 3, concerning minimum facilities required with the first two years of college chemistry, are listed suggestions concerning laboratory space and equipment and recommendations for the library.

Problem 4, which deals with competencies of an individual to teach chemistry during the first two years of college chemistry, states that the instructor should not have less than an M.S. degree of the usual type involving research thesis or an M.S. in Teaching degree involving a major in chemistry and a period of internship in a college chemistry situation. It is also emphasized that if a junior college is unable to attain adequately trained instructors it would be far better not to offer a course than to offer it with inadequate instruction and thus lead to the inevitable disappointment and difficulty which the students would encounter upon transferring to a four-year institution. Everything possible should be done to enable junior college chemistry teachers to achieve professional status as chemists.

The report was then circulated to the junior college chemistry teachers for their analysis and reactions. Early in January 1964 the committee representing the state universities and junior colleges was brought together to plan an articulation conference on chemistry. It was decided that chemistry instructional personnel in the public junior colleges and public universities of Florida would participate officially in the conference. The private institutions were invited to send observers. A record of the articulation conference held on May 7, 1964 was published later in 1964 by the State Board of Education Professional Committee for Relating Public Secondary and Higher Education. The purpose of the conference was to facilitate the transfer of students in chemistry from the junior to the senior colleges and to discuss ways and means of improving instruction in chemistry at all state institutions of higher learning. Twenty-six representatives from state junior colleges and 28 representatives from the senior colleges and universities attended the meeting. The private four-year institutions also in the state were represented. The meeting was held in connection with the annual state-wide meeting of the American Chemical Society and it was felt that one of the most important benefits accruing from this meeting was the opportunity for professional contacts and activities by the junior college members of the group.

The conference was planned to allow maximum participation by holding three separate round table sessions during which time the participants were divided into three groups to discuss separately organic, analytical, and general chemistry. A detailed summary of the various conclusions and recommendations involving each of the areas of chemistry dealt with in the conference is embodied in the conference report. I will mention a few of the more general opinions and recommendations arrived at by the conference.

1. The idea of meeting in a conference of this type met with uniform approval. In addition to getting together to spell out the particulars in each type of course and in both types of institutions, it was felt that a periodic exchange of ideas afforded by such a conference would advance the cause of chemistry teaching in all institutions.
2. In general it was felt that the course outlines presented were acceptable models for both the junior and senior colleges to follow.
3. Transferability of grades was discussed and it was agreed that credit should be transferred only when a student has taken the full two terms of a two-term course. It has been a general experience that students usually are unsuccessful when they take one half-course at one institution and the remainder at another.

4. The professional status of the junior college teacher came in for considerable discussion and it was felt by many of the participants that both the junior college administration and the faculty members themselves could assist in improving their status.
5. Finally, methods for the improvements and teaching in the junior colleges were discussed and a number of suggestions were made for programs to assist in this area. These included the development of an exchange program between the junior and senior colleges and an in-service training program.

In addition to these several general conclusions, I would like to mention a few of the specific conclusions and recommendations made in the three areas.

1. General chemistry. In general it was felt that one of the most important roles that the junior college can play, both for the potential chemistry major and for students whose major interests lie outside of chemistry, is to provide a firm background in elementary chemistry, especially for the student who is not yet ready for the more rigorous and accelerated pace of the senior institution. To this end it was strongly recommended that a three-trimester program in general chemistry be initiated by all of the concerned institutions. It was agreed that in this slower pace even the students of inferior preparation would be able to come up to a level of competency that would permit them to go on in chemistry or another science with an excellent chance for eventual success. It seemed to be of general consensus that the fourth trimester could be most profitably spent in the area of quantitative analysis. This does not imply that organic chemistry should be omitted from the junior college curriculum, since many terminal students require it, but only that potential transfer students not be encouraged to attempt too much in the first two years.
2. Analytical chemistry. The discussions again were centered around the committee report distributed in advance. There was general agreement that the description of a typical analytical course was reasonable. There were a good many questions about desirable length for analytical chemistry courses. Six hours of lab and two or three of lecture was recommended.
3. Organic chemistry. The discussions in the organic group mainly were centered around the emphasis to be placed upon specific topics. Some participants felt that the committee report was insufficiently specific concerning which areas should require major emphasis. It was pointed out that the report was intended simply as a guide to the general trend of increased emphasis on the theoretical pattern of organic chemistry and the integrated discussion of aliphatic and aromatic compounds which is now in general use. Standard glassware should be used whenever possible, particularly in the case of new programs undergoing development. The laboratory's portion of the course should involve a three-hour period as a minimum; some qualitative analysis should be introduced intc the laboratory program.

The planning committee met immediately following the conference in order to assess the value and results obtained at the meeting. It was decided that the planning committee should become permanent as authorized by the State Department of Education to continue to permit better articulation in chemistry. Further it was decided that a program aimed at bringing junior college teachers to the annual Meeting-in-Miniature of the Florida Section of the American Chemical Society should be continued. The plan adopted by the committee was to hold a conference on articulation every other year, with the intervening year to be filled by having special programs planned for junior college participants integrated with the regular program of the Meeting-in-Miniature held at the University of Florida. This conference had two phases; (1) reviews by specialists of topics recently introduced in the first two years of college chemistry; (2) presentation of submitted papers dealing with innovations in demonstrations, laboratory experiments, other teaching methods and curriculum. Phase 2

afforded an opportunity for junior college faculties to make contributions to the meeting. The results of the 1965 Meeting-in-Miniature again were very favorable and have encouraged us to continue planning this type of program for the future.

A meeting of the Committee on Articulation of Chemistry Programs was held at the University of South Florida in December, 1965. At this meeting it was decided that a general conference of all junior and senior colleges should be called for on Thursday, May 5, 1966, the day preceding the Florida ACS Section Meeting-in-Miniature. Invitations to the junior colleges will be sent through the President's offices, issued through Dr. Wattenbarger of the State Board of Education. It has been our experience that this invitation procedure is necessary in order to make it possible for the junior college teachers to be given the time off in order to attend.

The conference is to be held at the University of South Florida. The invitations are to stress the importance of having attendance by the faculty members at the scientific programs on Friday and Saturday. A five-man committee was nominated to plan the details of the conference.

The following suggestions were made about the organization of the conference and about topics to be discussed:

1. Invitations for brief reports on the impact of the previous articulation conference.
2. Evaluation of textbooks.
3. Chemistry for non-science majors.
4. Laboratory experiments, equipment needs.
5. Problems of placing students in the right courses when more than one type is offered.
6. Keeping up with trends in the high school instruction.
7. A very important topic that all agreed upon for full exploration is the problems of fitting junior college curricula into the variety of senior college programs. It is important to be sure that a thoroughly knowledgeable expert be present to field all questions.
8. There were favorable comments about organizing sessions around course content in general, analytical and organic.
9. There was favorable comment about having invited discussion leaders.
10. Problems of equivalence of courses --intra-college, intra-university and throughout.

It was agreed that an up-to-date report concerning articulation should be made following the conference, as it is very important that this information is made available to the planners of curricula for their new junior colleges so that their programs need not suffer.

It has become clear to those concerned about the problem of articulation that if the objectives of the program in higher education of the state of Florida are to be achieved, regular and effective communication between the faculties of the junior and senior colleges in the various disciplines is absolutely essential. To this end we have prepared a document of guide lines of conferences and meetings which are concerned chiefly with achieving a sufficient degree of articulation between the chemistry programs of the junior and senior colleges to allow for smooth and efficient transfer of students from the junior to the senior college.

The State University System Committee on
Articulation of Chemistry Instruction

Dr. Harry Sisler, University of Florida
Dr. Russell H. Johnsen, Florida State University
Dr. DeLos DeTar, Florida State University
Miss Barbara McRae, Florida A & M University
Mr. Walter H. Ellis, Florida A & M University
Dr. P. Calvin Maybury, Chairman, University of South Florida
Dr. Sam Clark, Florida Atlantic University
Dr. J. R. Strawbridge, State Board of Education

5.

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER IN FLORIDA

by

A. W. Gay

To the junior college student who has an adequate high school background and who is enrolled in a university-parallel program, the transfer to a senior institution may appear to be a simple procedure to be requested at the end of a two-year period. The student accepts the magic word, "accredited," which has been assigned to the junior college by some regional agency, as a guarantee that course content, the teacher-student relationship, and the facilities are such that success in his junior year program is nearly automatic.

These are important details which this student will take for granted. In terms of content, the student accepts the course description given in the catalog, the course outline given to him by the instructor, the texts sold to him by the bookstore, and experiments required of him in the laboratory to be comparable to those at the senior institution. He expects a rigorous course.

He expects his instructor to be a college-level teacher, making sound interpretations out of a background of academic and practical experience. He expects his instructor to give the necessary time and effort to each class preparation so that a clear presentation results and problem solving shows no lack of confidence. He expects his instructor to be demanding but reasonable, using justifiable testing and grading procedures. In the laboratory, his instructor sets the example in his use of accepted laboratory techniques. The student takes pride and added confidence in that instructor who takes time to read his professional literature, attend his professional meetings (ACS), and maintain a good rapport with his colleagues at the senior institutions.

The student can accept makeshift classrooms and may even take pride in the frugality of a struggling institution in this matter. But he expects the library and the laboratories to be adequately stocked so that he can do the same work in them that he would be required to do at the senior college. Fortunately for the laboratories, the advent of semimicro techniques has somewhat eased the demand on budget and space. In the laboratory the student expects the facilities prepared and the instructor competent to cope with emergencies.

But the accreditation by a regional body does not guarantee that all of this is true or that, if it is true, that it will remain so. Senior institutions shift emphasis and rearrange programs. In the sciences, break-throughs occur, new theories develop, information long at the graduate level sifts down into first year chemistry texts. The war and post-war babies arrive on campus and state universities establish high minimum qualifications; junior colleges receive their mandate to educate the masses below the eightieth percentile. Tired high school and junior high school teachers with the master's degree in subject matter move to the junior college. Former university professors come out of retirement. Retirees from the armed forces obtain teaching certificates. It is in this cosmopolitan group that today's junior college transfer student finds himself. Is all well for him?

For years, watch dog over articulation was the college registrar. It was he who learned officially of program changes, who received complaints from those receiving losses in credit, and who learned first of prerequisites. To the official liaison was added the feedback from transfer students. A definite assist to the minimizing of articulation problems came from those members of the junior college faculty doing graduate work at the universities.

Basis for the first organized attempts to deal with articulation problems was the Florida Association of Colleges and Universities. The first annual meeting of FACU was held in 1934. Membership in this organization is open to both public and private senior and junior colleges. Participation in its deliberations is open to any faculty member. Although the participation by faculty members was never outstanding, the existence of such an organization where administrators and teaching faculty members from both levels could meet as peers made for the development of a good rapport.

During the years 1954-1956, the theme of each annual meeting was articulation between high schools and colleges.(1). The next three annual meetings dealt with articulation in subject area fields: 1957,English and mathematics; 1958,biology, chemistry, and physics; 1959,social sciences.

These discussions could not help but point out the objectives and problems common to both junior and senior colleges. With this background, the two college groups had valuable preparation for studying the articulation problems existing for the junior college transfer student.

There were four public junior colleges in Florida by 1959. This had been made possible by action of the State Legislature in its Minimum Foundation Act of 1947. The rapid change taking place in the ensuing 13 years is brought out by Dr. James L. Wattenbarger, Director, Division of Community Junior Colleges, Florida State Department of Education:

"In the fall of 1962, over half of the Florida freshmen who enrolled in higher education were enrolled in Florida's public junior colleges... The percentage of freshmen enrolled in junior colleges has increased each year;... There were 29 junior colleges operating in 17 junior college areas located within commuting distance of 63 percent of the state's high school graduates."(2).

With the integrating of some white and Negro junior colleges and the opening of additional junior colleges, by 1968 Florida will have 30 public junior colleges within commuting distance for nearly 90 percent of the state's high school graduates.

The rapid expansion of the public junior college system with its single qualification for admission -- the high school diploma or equivalent -- created problems in terms of content, teacher-student relationship, and facilities for the junior college transfer student.

To consider the matters of articulation, Governor Leroy Collins in 1960 appointed a Professional Committee for Relating Public Secondary and Higher Education. This committee has been continued by the two administrations since.

Discussion of these problems "between the Division of Community Junior Colleges and the Council of Presidents of the State Universities led to the conclusion that a conference on articulation of mathematics and science in higher education was desirable. The general purpose of the meeting was established as follows:

"1. To interchange information on what is being done at Florida's state supported universities in the freshman and sophomore level course work of chemistry, mathematics, physics, and engineering graphics and on what is expected of a student transferring from a Florida junior college or other institution to a state university, when the student expects to pursue a baccalaureate program in chemistry, physics, mathematics, or engineering.

"2. To establish a system of communication in the subject areas of chemistry, physics, mathematics, and engineering between the junior colleges and the senior institutions of the state whereby a better understanding of course content and curricula requirements can be effected, and where advance information concerning these matters can be publicized at an early date.

"3. To explore ideas whereby the institutions of higher learning of the State can assist one another in raising the quality of their programs, thus serving the people of the State.

"4. To get to know one another and become familiar with our respective, yet mutual, problems.

"5. To lead the way for other academic areas which have similar problems."(3).

The outcome was the Conference on Articulation for Freshman and Sophomore Mathematics, Chemistry, Physics and Engineering Graphics sponsored by the Professional Committee for Relating Public Secondary and Higher Education. The conference was held in May, 1961 at the University of Florida. Attending were 43 persons representing 12 state and private senior colleges, 44 persons representing 23 public junior colleges, and three persons representing the State Department of Education.

After a general meeting, the five state senior institutions individually explained their courses for the first two years of the areas being considered. The first day of the conference ended with separate meetings for junior college and for senior institution personnel.

The following morning, the first part of the session dealt with upper division requirements in these areas. In the second part of the session, a panel discussed mutual problems of the two college groups.

Three paragraphs are taken from the report given by the group dealing with articulation in chemistry:(4)

"The general tone of the presentations and discussions of the chemistry section was emphasized by two main points: one, that the classical curriculum and course content are being changed radically and two, that these changes are actually rather uniform at the senior universities."

"The four senior universities unanimously agree, in response to direct questions, that full transfer credit would be given for General Chemistry or any combination of General Chemistry, Organic Chemistry, and Quantitative Analysis. The universities also recommended that the junior colleges install Organic Chemistry, because of the ease of staffing and lower operational expense, as the second year course before they add the much more expensive one-semester course in Quantitative Analysis.

"The general consensus was that while the four-year programs appeared quite dissimilar at first glance they were almost identical in both philosophy and scope."

Included in the "Proceedings -- Conference on Articulation" were the suggestions:(5)

"1. The senior colleges should consider bringing junior college people to their campus during the summer to work with university research people in pursuing work in their fields.

"2. It was thought that support might be obtained for a summer seminar for junior college people to review significant textbooks in their respective fields with their counterparts in the senior colleges.

"3. It was suggested that the senior colleges and the junior colleges explore the possibility of exchanging the faculties on a semester, summer school, or full academic year basis.

"4. An internship program was suggested for new faculty at junior colleges whereby those people would spend one semester at one of the state senior institutions..."

The consensus of the Continuity Committee was that a follow-up conference should not be held before late 1963 or early 1964.

In July, 1963 the Board of Control issued a 23-page handbook, "Articulation of Chemistry Instruction in the Public Junior Colleges and the Institutions of the University System of Florida." The handbook was prepared by the State University System Committee on Articulation of Chemistry Instruction. Representatives from five state senior institutions and one from the Board of Control made up the eight members of the committee.

The introduction stated, "If the objectives of the program in higher education of the State of Florida are to be achieved, regular and effective communication between the faculties of the junior and senior colleges in the various disciplines is absolutely essential. This document was prepared with the air of fostering such communication between chemistry faculties in the state institutions. We are concerned chiefly with achieving a sufficient degree of articulation between the chemistry programs of the junior and senior colleges to allow for smooth and efficient transfer of the students from the junior to the senior college." (6).

The handbook drew heavily from "Minimum Standards Used as Criteria in Evaluating Undergraduate Professional Education in Chemistry," published by the American Chemical Society. The section dealing with curriculum was quoted in its entirety.(7).

The introduction went on to state: "The universities recognize the various problems which the junior colleges face in obtaining appropriate faculties and adequate staff and are prepared to make every possible adjustment to meet the needs of the student who has not had certain courses normally expected to have been taken during his first two years...

"Because of the different sequence of topics in general chemistry courses as they are taught in the various universities and colleges in the state, it is strongly recommended that no junior college student seek to transfer credit for only one semester (or trimester) of general chemistry. General Chemistry should be considered a one-year course which is non-transferable unless the complete year is finished."(8).

Under "II. Competencies Which Are Expected of Students Entering Their Third Year of College Chemistry," the committee listed minimum recommended course content for general chemistry, one-semester analytical chemistry, and one-year organic chemistry. The committee made clear, "These do not represent course syllabi nor are they presented as course outlines."(9).

The remainder of the handbook considered the following topics:

"III. Competencies Which Are Expected of Students Entering the Study of Chemistry in the First Two Years of College."

"IV. Minimum Facilities Which Should Be Available."

"V. Competencies Which A Department Head, Dean, or President Should Look For in Employing Individuals to Teach Chemistry During the First Two Years of College."

"VI. Characteristics of General Chemistry Courses Which Should Be Used to Serve the Purpose of A Variety of Students Who Do Not Plan to Continue Beyond a First College Chemistry Course."

The handbook was transmitted to the junior colleges by the Director of the Division of Community Junior Colleges.

In order that the reaction of the junior colleges could be evaluated and that problems peculiar to the articulation of chemistry programs could be studied, a meeting of the two college groups was necessary. Seven junior college instructors were appointed by the Director of the Division of Junior Colleges to serve with him, with representatives from the state senior institutions and with a representative from the Board of Control, as a planning committee for an articulation conference in the spring of 1964.

Believing that the value of membership in the American Chemical Society and of participation in its meetings should be emphasized, the conference was planned to just precede the Meeting-in-Miniature of the Florida Section of the ACS.

To express the reactions of the two college groups at the proposed general meeting, a representative was selected from each. The planning called for simultaneous roundtable discussions in three groups, General Chemistry, Analytical Chemistry, Organic Chemistry. So that instructors might benefit from discussion in all three areas, the committee set up three sessions of roundtable discussions. The conference was to end in the afternoon, thus allowing the participants to join in the ACS mixer in the evening.

Fifty-four representatives attended the conference held in May at the Florida State University. Of those present, 26 came from 17 junior colleges (one private) and 28 came from ten senior institutions (five private).

An excellent rapport developed in the sessions. The junior colleges' faculty members were impressed with the understanding of junior college problems which the representatives from the senior institutions possessed. There was evidenced a uniform approval of this type of meeting.

"The discussions of the various groups centered, of course, around the validity of the recommendations of the preliminary document. In general, it was felt that the course outlines presented were acceptable models for both junior and senior colleges to follow..." (10).

A discussion of the professional status of the junior college teacher developed the conclusion that administration must recognize members of the chemistry faculty as belonging to the chemical profession and that they have professional oblications to that group. It was also pointed out that these faculty members have the responsibility of participating

in professional activities. Participation in the activities of the Florida Section of the American Chemical Society was recommended as a method of enhancing the status of the junior college teacher.

One of the high points of the summary sessions was the statement of Dr. Wattenbarger that Florida law no longer requires credit in professional education courses for certification as a junior college teacher. Only a major in the subject matter is required. The group showed its approval.

The idea of an exchange program between the junior and senior colleges was again suggested.

In the subject matter areas there were specific recommendations. Thermodynamics, at first thought too advanced for the junior college student, can be included by treating some of the standard topics in a little more sophisticated way. Junior colleges can concentrate in giving a solid background of elementary chemistry by spreading the course over a three-semester (trimester) program. The fourth semester can be assigned for quantitative analysis.

Some instrumentation should be included in analytical chemistry. A good beginning would involve a pH meter and a Spectronic 20.

Recommendations for organic courses were that standard taper glassware be used when possible, that laboratories be a minimum of three hours in length, and ACS Organic Examination be used in upgrading the course.

Junior college personnel were encouraged to visit the nearest senior institution; senior college personnel were encouraged to visit the nearby junior colleges. The institutes sponsored by the National Science Foundation were emphasized as a means of upgrading the junior college instructor.

At the conclusion of the conference, the planning committee was of the opinion that an annual meeting dealing only in problems of articulation was hardly necessary. Rather, the committee recommended a meeting in which specialists would present general papers in some of the topics now coming down into the courses of the first two years. Papers on curriculum modifications and instructional innovations were invited from the junior college faculties.

More specific planning for the 1965 conference occurred at a meeting of the committee called by the Chairman of Continuing Activities in Chemistry Articulation, Dr. P. Calvin Maybury, University of South Florida. It was recommended that the Florida Section of the American Chemical Society be requested to allow the committee to arrange for an undergraduate chemistry articulation conference as a part of the 1965 Meeting-in-Miniature. The request was favorably received by the Florida Section and two sessions were allotted the conference.(11).

The first session with Dr. DeLos F. DeTar of Florida State University presiding, consisted of four papers:

"The New Elements," by Dr. Gregory R. Choppin, Florida State University.

"Chemistry of the Helium Family," by Dr. Harry H. Sisler, University of Florida.

"Experimental Procedures for Multiple Measurement of the Charge on the Electron," by Lloyd Remington, St. Petersburg Junior College.

"A Four-Semester Sequence in General Chemistry at the St. Petersburg Junior College," by Nelson McKaig, St. Petersburg Junior College.

Dr. Sisler presided at the second session in which four more papers were given:

"Gas Chromatography," by Dr. Charles K. Mann, Florida State University.

"Thermodynamics in the Teaching of General Chemistry," by Dr. George E. Ryschkewitsch, University of Florida.

"The Use of Cork Balls for Increase of Versatility of Standard Ball-and-Stick Molecular Model Sets," by Harry M. Duvall.

"Lecture Demonstration of the Slow Rate at Which Steam Condenses on the Surface of an Undisturbed Pool of Cold Water," by Lewis C. Wallace.

Have these organized attempts to improve articulation in chemistry instruction been of value? It is too early for the senior institutions to give an answer. What is the reaction of the junior college faculties and administration?

Interviews were held with representatives of eight junior colleges. All believed that the conferences had made valuable contributions to their programs, and all favored continuing the conferences.

Six of these reported that an additional semester had been added to the general chemistry program as a result of the conferences. One junior college reported the addition of quantitative analysis to its program.

Three of the junior colleges reported that the general courses were being upgraded by the inclusion of more sophisticated material. Another reported that there had been a change in emphasis.

The chemistry instructor in a small junior college credits articulation conferences with bringing about the upgrading of subject matter, of testing, and of the instructor. He favors the continuation of the conferences for his own professional growth. He mentioned specific upgrading in the teaching of chemical equilibrium. A remedial program was also an outgrowth of the articulation conferences.

Present at the recent meeting of the planning committee were two teachers who recently joined two Florida public junior colleges. One came from a background of college teaching. Both expressed the belief that the objectives of the articulation conferences were most worthwhile and fitted into the needs as they saw them. One of these instructors came from a smaller junior college where he was the only chemistry instructor; the other came from the largest junior college which has a fair-sized chemistry faculty.

This paper has shown the development of a method of dealing with problems which attend the junior college transfer. It has shown few solutions, if any, but there has developed a healthy atmosphere in which the junior college instructor and the senior college professor are working together on a common problem. This continued contact is going to make for better higher education in Florida.

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Critique of P. C. Maybury's paper

THE JUNIOR COLLEGE TRANSFER IN FLORIDA UNIVERSITIES

and of A. W. Gay's paper

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER IN FLORIDA

by

L. H. Hellberg

One's first reactions to the "Articulation Program in Chemistry in the Public Junior Colleges and the Institutions of the University System of Florida" comprised both wonderment and pleasure: wonderment at the relative smoothness with which such a program has developed on such a large scale so quickly since 1963; pleasure at such outgrowth as

1) the emphasis on professional status as chemists for junior college chemistry teachers,

2) the provision of suggested minimum laboratory, library and equipment facilities for junior college chemistry programs presently in operation and yet to be developed,

3) the strong support for recommending that a junior college chemistry instructor have an M.S. degree at least (and, with professional education courses no longer required in Florida, resulting in a strong subject-centered degree), and

4) provision for: (a) regular (annual) meeting of interested junior and senior college and university chemistry faculty to exchange ideas on articulation, and (b) subsequent publication of such conferences' results to make them widely available.

But there remain certain features (as presented in these papers) of the program, both proposed and those already in operation, that are suggestive of rigidity that is unnecessary, undesirable and/or unworkable in practice.

1) The junior college student, invariably residing at home, is often a part-time worker. Thus, he may not be able to fit the second semester of a year organic chemistry course into his junior college program because of schedule conflicts. Is it fair to deny to a student (or even suggest denial) credit for the first semester of the course (See Maybury report, 5/1964 Articulation Conference) on the basis alone that he hasn't complied with the desired wish to taking the year course all at one school? Rather, might not this difficulty be resolved by each senior school introducing a testing program to see if such a student is capable of directly entering the second semester of organic chemistry?

2) A proposed faculty exchange program between junior and senior colleges would never be operative, at least not to a significant degree. From my limited acquaintance with senior college and university chemistry faculty, I would venture to say very few of them would be willing to spend a semester or year at a junior college. And I see nothing in the future that will cause a change in their attitudes.

3) The proposed summer seminar to review significant textbooks seems undesirable. Of course, instructors ought to select texts with care. Rather than a lengthy summer session, however, perhaps a three to four hour discussion on texts in a particular field (i.e., organic, general) of chemistry during the course of an articulatory conference (as suggested for Florida, 1956) would be more convenient and nearly as helpful.

4) The adoption of a three-trimester program in general chemistry (Maybury, 1964 Conference) would almost certainly prevent a chemistry major so enrolled from completing his bachelor's degree studies in four years. Many feel it is desirable all college students, including those attending junior college first and then senior schools, complete their studies in four years. If so, it would seem more desirable to add an extra unit each semester to the year junior college general chemistry course (for which junior college graduation credit would be given but the senior school would not accept transfer credit) to permit poorly-prepared students to achieve competency equivalent to that reached by students at the end of the year course in the senior schools.

5) At an early stage of this articulation program, detailed minimum course contents for general chemistry, one-year organic chemistry and one-semester analytical chemistry were proposed by the state universities of Florida. These were later informally accepted as course outlines by the junior college chemistry teachers, though the idea of course outlines was not the original intention of the universities. (Perhaps it would be helpful to include these outlines.) While such outlines seem meritorious, it seems questionable to spend so much time in their preparation and upkeep. At least, this would appear so from the organic chemistry outline as read to the conference by Professor Maybury. As I recall, everyone who teaches organic chemistry would find the outline acceptable except perhaps those teachers who have not paid any attention to organic chemistry's developments of the past 30 years. What purpose, then, has the course outline served? Perhaps, but only perhaps, the old-time, out-of-date teacher might be stimulated, but little else has been served. Moreover, such an outline, as Professor Jacobs of UCLA repeatedly stressed, does not describe attitudes and approaches to organic chemistry that the teacher ought to have and that ought to be instilled into the student during such a course.

In conclusion, such an articulation program is helpful, especially insofar as communication of program changes and transfer difficulties among colleges are concerned. However, it would still appear that many of the difficulties with regard to course content (the "meat" of the matter) could be resolved if adequate attention were paid to the graduate training of prospective junior college chemistry teachers, especially the attitude of their being ever aware and interested in current developments and including such in their teaching.

6.

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER STUDENT AS SEEN FROM THE UNIVERSITY OF CALIFORNIA AT BERKELEY

by

D. S. Noyce

The topic to which we are addressing our discussion today is the role of the junior college in preparing students in the college programs both for their subsequent years at the university and for their subsequent careers, specifically as it may involve chemistry, either as a major, or as a supporting discipline. Thus we should not overlook the important place of chemistry in other majors or professional fields, such as the biological sciences, medicine, dentistry and engineering.

I would like to approach the discussion of these problems in a somewhat more personal manner than has been done up to the present. I have chosen to take the graduating class of 1955 from the College of Chemistry at Berkeley as a typical group of students and to examine their records and subsequent performance. The College of Chemistry includes two majors, the chemistry major leading to a Bachelor of Science degree in chemistry, and the Chemical Engineering major also leading to the Bachelor of Science degree. I have treated the two majors together, as we are here concerned about questions common to both majors: the problems of the students, the difficulties of articulation, and the questions of subsequent performance.

The problems of the junior college student are many. In order to allay any possible misapprehensions, we ought more carefully to identify who the junior college students are, and how they come to the University.

I would like to address my remarks to three questions:

1. Who are the junior college transfer students?
2. What has been our past experience in helping transfer students?
3. What suggestions can be made for the future?

If we now look at the specific group of students, to which I referred earlier, we find the following: the graduating class from the College of Chemistry in 1955 numbered 55. In this group there were 36 chemistry majors and 19 chemical engineering majors. Of this group there were 20 junior college transfer students; and 13 of these completed the major in chemistry and seven completed the curriculum in chemical engineering.

What has happened to these students since that time? Of the total class, to my knowledge, 18 of them have gone on for advanced degrees - nine Ph.D.'s in chemistry and ten M.S. degrees in a variety of subjects: metallurgy, engineering science, sanitary engineering, chemical engineering, etc. These are absolutely minimum figures, and the lack of information regarding many of the other students probably implies that these numbers should be increased by an appreciable fraction.

In this class, there were a total of 20 students who were transfers from junior colleges. All but one of them completed a minimum of 55 units in the junior college; generally they were at Berkeley for two years. Of this group of transfer students there was one who completed his Ph.D. at Stanford. One completed his Ph.D. at Purdue in nuclear chemistry, and one has recently returned to graduate study in chemistry at Davis after several years of employment. Additionally, the group of transfer students earned a total of three master's degrees in a variety of fields.

The majority of these students were scholastically eligible to enter the University at the time they graduated from high school. On standardized college tests, many of them scored in the 90th percentile or better (for high school seniors) but one scored below the median of high school students .

The junior college students who transfer to the University are thus a very interesting and diverse group of students. They represent a particularly wide range of native ability

as measured by a variety of criteria. I want to emphasize that the image of the junior college student in many quarters as the student who was not eligible to enter the University as a freshman is by no means a correct one.

Rather we find that the chemistry transfers were, in general, students who, though eligible to enter the University, chose to attend junior college for a variety of reasons.

How do these students perform once they transfer to the University? Very well, in general. Based upon junior college grades, they drop only about one-third to one-half a grade point. The average junior college grades for this group were 2.89; the grade point average for the junior and senior year at Berkeley was 2.50.

These junior college students came from nine different junior colleges around the state from Yuba City to Fullerton, from Modesto to City College of San Francisco, which supplies a good-sized group. Of the 50 persons who are teaching at these junior colleges, nine have a Ph.D. degree in chemistry or science, and 35 have a Master's degree in chemistry.

I have emphasized these facts, to indicate the very strong preparation which students may receive at the junior college. Obviously many of the students have gone to junior college rather than the University for personal and financial reasons.

What have we done at Berkeley to help the transfer student adjust to the University? In my own personal experience there have been several specific things. The junior college students entering the University for a chemistry major or a chemical engineering major in the College of Chemistry have been assisted by a special adviser--a senior staff member who has taken particular pains to become acquainted with the problems of the transfer student over a period of years. The course schedule which the student normally takes as he enters the University can reflect his special situation.

One can try to make the courses in the junior year adaptable to students of different backgrounds. The second semester of organic chemistry, Chemistry 112 at Berkeley, is the focus of the most difficult problems of articulation. There are several ways that I feel we can go about alleviating these difficulties. One can make an effort to sketch out during various lectures in the early weeks of the semester those topics which are essentially new and those which expand the material in the text being used. With information of this sort the able student, the independently-oriented student who can study on his own, can determine where his background may be skimpy. He can then review or fill in and go ahead and come out satisfactorily at the end of that semester.

By and large, the performance of the transfer student at Berkeley has been excellent in the past.

But what of the future? It has several uncertainties. First of all, there has been, in very recent years, a substantial revision in the patterning of chemistry courses. There has been a major readjustment in the standard nature of the courses suggested by the American Chemical Society Committee on Professional Training. There has been the ferment caused by the various study programs such as the CHEM study program and the CBA study program. There have been several experimental college programs, such as the experimental program at Brown, or the combined two-year sequence at Harvard. Finally, there has been the leavening effect of the work of this Council.

Each one of these changes would have been sufficient to create real problems in articulation, in understanding, and in communication. Taken together, it is possible that the situation may become chaotic. What do we do about it?

These changes have upset the pattern which I was describing above, a situation which might be characterized as a stable and mature society. In the decades preceding World War II and in the decade following World War II, the rather static nature of freshman chemistry meant that the persons teaching at the junior college could easily receive feedback information regarding the performance of their students in subsequent years at the University; and, if there were necessity for it, they could make adjustments in the nature of the material discussed, the emphasis placed upon certain aspects of understanding, and the like. It was clear during this period that the junior college teachers knew what an A grade

or a B grade represented; they did, however, tend to be somewhat more lenient with C grades than might have been the case at the University. Recent curriculum changes have removed the possibility for this more relaxed pace of feedback information to operate as a smoothly self-adjusting system, and we are now facing what amounts to a crisis in articulation.

The problem in its totality has these facets: (1) the dual responsiblity of the junior college for both transfer students and terminal students; (2) the changing place of quantitative analysis in the chemistry curriculum; (3) the developing role of instrumentation; (4) the steady progression of organic chemistry into the sophomore year; (5) the tendency for physical chemistry to begin late in the sophomore year.

I would like to suggest a specific program which may meet this problem. We need to prepare the junior colleges for introducing physical chemistry--for a variety of reasons. Whether the junior college program in chemistry is thought of in terms of the first two years of the university curriculum or whether it is thought of also in terms of a two-year terminal education or technical aide training program, the value of thermodynamics is not to be denied. Both introduction of some of the quantitative rigor of thought represented by thermodynamics and also the understanding of reactions and equilibria are essential to improve the foundation upon which either track of students will continue to build up in subsequent years. A student late in his sophomore year normally has at his disposal sufficient mathematical preparation and background in physics to be able to take a very good and strong dose of thermodynamics in the last quarter of his sophomore year. The reorganization of the curriculum at Berkeley in anticipation of the quarter system and year round operation specifically takes account of the fact that the last part of the sophomore year is the place to begin study of physical chemistry -- with a course in thermodynamics followed in subsequent quarters with molecular spectroscopy and other methods of determining molecular structure, the dynamic properties of chemical systems and, in the third quarter, an introduction to statistical mechanics.

Furthermore this sophomore year may or may not include formal instruction in quantitative analysis -- certainly it is less likely to in the future than at present. Thus there becomes available in the sophomore year additional time -- which requires very careful consideration of the topics which might be included. Two alternative suggestions come to mind. The student may take two quarters of organic chemistry; or he may take a quarter of biochemistry subsequent to the organic chemistry -- these in addition to the rigorous thermodynamics quarter which I mentioned earlier.

Let us consider how this fits into the two-fold function of the junior college (as represented in the Master Plan of the State of California). The two-year technical aide program at the junior college would then include quantitative analysis, organic chemistry and thermodynamics. Substitution for one of these courses of a more specially designed laboratory course for the terminal student would be possible. However, I would urge retaining the full sequence of courses in these three fields -- and for the terminal student adding the laboratory work designed more particularly for his needs.

For the student who plans to transfer, the junior college program will fully prepare him to enter the junior year at the university. The junior year will then include the third quarter of organic chemistry and the second and third quarters of physical chemistry.

This is not going to make life easy for the junior college teacher. The readjustments represented by such a drastic change in course sequence from the traditional pattern is fraught with problems, not the least of which is the shifting required to make use of present laboratory facilities for substantially different courses. However, at the same time, there is the opportunity to establish greater and more varied basic preparation in a larger fraction of the fields of chemistry which are represented in the work of the practicing chemist of the present and future.

Critique of D. S. Noyce's paper

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER STUDENT AS SEEN FROM THE UNIVERSITY OF CALIFORNIA AT BERKELEY

by

J. K. Holmes

My comments on Professor Noyce's talk are conditioned by what has been said by others during the day so they reflect considerations on the teaching of organic chemistry at UCLA as well as at Berkeley.

One of the basic problems in some junior colleges is that what is offered is in part determined by class size. At Hartnell, for several years, we have been offering Chemistry 8 (survey of organic for preprofessional and biological science majors) and Chemistry 12 (organic chemistry for chemistry majors) concurrently during the spring semester. Students in both courses attend the same lecture; laboratory experiments differ somewhat, greater emphasis being placed on some kinetics as well as on the standard techniques and preparations in Chemistry 12. The net result of this procedure is that we probably overfeed Chemistry 8 students while we underfeed Chem 12 students. At the end of the semester, students in Chemistry 12 with A or B grades are counselled to take Chemistry 112 at the university with the warning that they will need to swim hard but should be able to succeed in the course. Those whose grades are lower are counselled to take Chemistry 12 again and count their semester as useful experience. The second time through at least, they will not be wandering in completely uncharted territory. This procedure has enabled the better students to save a semester and has shown some of the others that they have limitations. As soon as class size and staffing permit, the courses in Chemistry 8 and Chemistry 12 will be given separately. At present it is not economically feasible to staff two separate courses. Current enrollments indicate that this separation can take place within the next year or two.

Another problem in the junior college is to attempt, by a variety of means, to provide competition among the abler students in order to prepare them for the greater competition they will encounter in the state college or at the university. We try to encourage as much competition as possible.

Another difficult problem is that of integrating semester offerings with the quarter offerings of the UC campuses. We will be faced with this problem next fall. It will be helpful if the junior colleges go on to the quarter system soon to make articulation of junior college and university programs somewhat simpler. This proposal is not likely to be received with complete approval by the junior colleges.

It will be difficult for us to give the beginning thermodynamics course before we go to the quarter system. There are going to be real difficulties in integrating this in to the sophomore year which consists of Chemistry 5 (quantitative analysis) followed in the spring semester by the one-semester courses in organic chemistry. A junior college transfer student transferring to UC Berkeley in the fall then is confronted with some choices. He has had Chemistry 12, which includes some of the concepts of Chemistry 12A and includes some of the material of Chemistry 12B. Does he wait to take 12B and then follow up with the thermodynamics course in the spring quarter?

One of the suggestions which has met with essentially complete agreement at this conference has been that a sequence of general chemistry or of organic chemistry should be completed at the junior college rather than transferring in the middle of the sequence. This is the big difficulty with our present practice: Chemistry 12 in the junior college followed by the second semester, Chemistry 112, at the university which results in interruption of the sequence. It appears to me to be more logical to offer a year sequence in organic chemistry at the junior college. This could be two semesters of organic chemistry to be called 12A-12B, which could be changed to a 12A-12B-12C sequence when the junior college goes to the quarter system. This would complete an organic chemistry sequence in the junior

college which can then be followed, upon transfer to the university, by the usual chemistry and advanced organic courses.

Previously it has been noted in this conference that UC Berkeley lists Chemistry 112 in its provisional catlaog as a lower division course but with an upper division number. This creates problems for the junior college and thus leads to the suggestion for a 12A - B - C numbering as suggested previously.

The transfer students from Hartnell go largely to UC Berkeley or UC Davis if they go to a branch of the university. Soon some of them will be transferring to UC Santa Cruz. Most of the rest of our transfer students go to San Francisco State, Cal Poly at San Luis Obispo, San Francisco State College and Fresno State College. San Jose State and San Francisco State Colleges offer organic chemistry as a year sequence in the junior year, while Cal Poly and Fresno State offer organic chemistry as a year sequence in the sophomore year.

Since, in general, the teaching of the initial course in organic chemistry calls for less mathematical sophistication than that required for physical chemistry then the initial year course in organic chemistry can be taught well and logically in the junior college.

I am also impelled to comment on the planned program in organic chemistry at UCLA as reported by Professor Pecsok and amplified by Professor Jacobs. This proposes organic chemistry courses with complete laboratory emphasis upon techniques and instrumental work in the sophomore year with preparational work being deferred to the junior year. My experience is that many students get great satisfaction from the creative feeling found when new compounds are being synthesized, and I feel there is danger of driving prospective chemistry majors out of the field of chemistry before they reach the synthetic phase which does appeal to many students. I would prefer to see preparation of compounds and analytical techniques used together to complement each other during the first year of organic chemistry.

We are constantly modifying our organic chemistry courses in an attempt to keep up with the change which is occurring in organic chemistry. One of the chief problems in doing this is that we need to increase the variety and types of instruments and equipment for teaching organic. It will be very helpful to us to have some guidelines on equipment considered essential to the laboratory work in the teaching of organic chemistry. Such a list of essential equipment carries the weight of authority from the outside and would not be considered a whim of the instructor. This gives us something to help in convincing our administration and the board of trustees that these pieces of equipment are being used increasingly in courses offered throughout the country. We will be attempting to integrate synthetic organic chemistry with techniques and instrumental analysis within the scope of acquisition of equipment which our limited budgets permit.

7.

THE NEW CHEMISTRY CURRICULUM AT UCLA AND ITS RELATION TO THE JUNIOR COLLEGE STUDENT

by

Robert L. Pecsok

INTRODUCTION

The UCLA Chemistry Department has taken advantage of the change in the university calendar from the semester to the quarter system (effective September, 1966) to make far reaching changes in its curriculum at all levels. Innovations are concentrated in the lower division program but a shifting of emphasis and a re-ordering of topics is reflected in upper division courses as well.

Some of the considerations which influenced our discussions were:

1. About 1,500 students begin Chemistry 1A at UCLA each year and about 400 of them continue with a second year of chemistry. We have a responsibility to these students to offer them the very best courses we can devise - challenging them to the limit of their ability. On the other hand, about 40 percent of our graduating chemistry majors are transfer students, largely from junior colleges, who have had two years of chemistry elsewhere. These often are among our best students. We have a responsibility to these students to keep our lower division courses (or at least the material covered) reasonably comparable to those courses which are or can be offered at junior colleges so that they can transfer with a minimum loss of time or duplication of effort.
2. The high school chemistry courses are significantly better than in the past. The proportion of our incoming students who have had CHEMS and CBA courses is increasing (now about 20 percent). The more traditional courses likewise have been upgraded. However, good laboratory preparation is not yet as prevalent.
3. The interests of chemistry majors and other science majors are similar enough to justify their taking the same courses for the first two years. Most of the other science majors and many of the chemistry majors are oriented toward the biological side of chemistry.
4. Analytical chemistry lies at the heart of almost every laboratory operation, regardless of whether inorganic, organic, physical or biochemistry is involved. Thus analytical chemistry should be taught using all of these applications in an integrated fashion rather than as a separate field of inorganic quantitative analysis. Likewise, careful analytical technique will be infused into the laboratory experience of other branches of chemistry at an early age.
5. The dependence of organic, analytical, inorganic and biochemistry on calculus and physics is less than that of physical chemistry, so physical chemistry should be deferred to the upper division. Furthermore, few besides chemistry majors take a rigorous physical chemistry course.
6. Organic chemistry has become much more dependent on instrumental data in recent years. There is much greater emphasis, from the beginning, on structure and reaction mechanisms. Students, whether they are continuing in chemistry or life sciences, should become familiar with the instrumental methods by which the data is obtained.

The courses for the first two years will be of most interest to junior colleges. UCLA has adopted a system in which the course is the unit rather than the credit-hour. A full-time student is expected to enroll in four courses, all of equal credit. There will be no attempt to standardize the number of hours required for each course, but four hours of class time (or the equivalent in quiz sections or laboratory) are considered normal. Half-courses and double courses will also be permitted.

LOWER DIVISION COURSES

Physical Sciences 2. A cultural course for non-science majors. Lectures, demonstrations, discussion and quiz sections - four hours per week. This one of a sequence of Physical Science courses, the first of which is physics and the second chemistry. The latter will assume an understanding of the material presented in the former. This sequence will be required for all non-science majors (or an equivalent course in physics and chemistry). We anticipate an enrollment of about 3,000 per year.

Chemistry 1ABC. Normal first year course for all science majors. Lecture and quiz sections - four hours per week; laboratory - one four-hour period per week. Prerequisites: high school chemistry, physics, and three years of mathematics. Admission to this course is by examination, and those who are well-prepared will enroll directly in Chemistry 1B.

Chemistry 1A Lecture Topics: A rapid, sophisticated review of topics covered in high school courses. Stoichiometry and atomic theory, atomic structure and periodic table, molecular structure and chemical properties, kinetic molecular theory and the gas laws, solutions, colligative properties. Laboratory Experiments: The balance and weighing, semi-quantitative analysis of a $KClO_3$-$NaCl$ mixture, generation and measurement of a gas, molecular weight of a volatile liquid, density of a solution, equivalent weight of an acid, colligative properties.

Chemistry 1B Lecture Topics. Molecular interactions, solid and liquid states, solutions and volumetric analysis, chemical and phase equilibria, thermochemistry and thermodynamics. Laboratory Experiments: Precise gravimetric choride, precise volumetric choride, thermochemistry, solution equilibria, use of a pH meter.

Chemistry 1C Lecture Topics: Redox systems, electrochemistry, chemical kinetics, nuclear chemistry, systematic descriptive chemistry. Laboratory Experiments: Qualitative analysis (one group), rate of a chemical reaction including the effect of temperature, quantitative redox titration, radiochemistry.

Chemistry 4ABC and 6ABC. Normal second-year course taken by most science majors (including life sciences). Chemistry 4 is a sequence of half-courses covering topics in elementary organic and biochemistry, with two hours of lecture per week. Chemistry 6 is a sequence of half-courses covering lectures and experiments in modern analytical methods used in organic and biochemistry, with two hours of lecture and one four-hour laboratory per week. Chemistry 4 and 6 must be taken concurrently, although exceptions will be permitted for students transferring from other institutions. An enrollment of 400-500 per year is anticipated. Each course will be offered each quarter. No more than 48 students (two sections of 24 each) will be in laboratory at any one time.

In these courses, we have achieved a new blend of topics. Most of the topics of traditional quantitative analysis will have been covered in the freshman course so that we can now present analytical chemistry as it will be done and used by those students in their future careers. The material will be far more useful and stimulating, and we trust will attract rather than dissuade potential chemistry majors. All our chemistry majors will now have an early exposure to biochemistry, and biological and premedical students will receive an introduction to the field as taught in a chemistry department.

Chemistry 4A Lecture Topics: Organic structure, the functional and hydrocarbon groups, compounds with saturated functional groups, compounds with unsaturated functional groups, reactions.

Chemistry 6A Lecture Topics: Phase equilibria, chromatography, spectra, structure determination. Laboratory Experiments: Separation of naphthalene and benzoic acid by extraction, distillation of solvent, crystallization of products, melting points of products and starting mixture (two periods); fractional distillation, followed by gas chromatography of distillate (one period); gas chromatographic experiment (one period); column chromatography of a reaction mixture, followed by thin-layer chromatography, isolation of products

(two periods); spectrophotometric experiment; determination of a π complex (one period); infrared demonstration and interpretation (one period); NMR demonstration and interpretation (one period).

Chemistry 4B Lecture Topics: Stereochemistry, structure and reactivity, substitution, addition and elimination reactions, syntheses, special topics.

Chemistry 6B Lecture Topics: Polarimetry, mass spectrometry, isotope labeling, electrochemistry, acidity, chelates, reaction kinetics. Laboratory Experiments: Experiment using home-made polarimeter (one period); mass spectrometry demonstration and interpretation (one period); combined spectrastructure interpretations (one period); titration using pH meter (one period); buffer experiment (one period); amino acid titration, pK_a and pK_b, isoelectric point (one period); non-aqueous titration (one period); chelate experiment (one period); kinetics of t-amylbromide methanolysis, followed by titration (one period).

Chemistry 4C Lecture Topics: Enzyme kinetics, amino acids, peptides and proteins; nucleic acids and nucleotides; genetic code; metabolism; glycolysis and citric acid cycle; carbon transformation.

Chemistry 6C Lecture Topics: Enzyme and chemical kinetics; radioisotope determinations, theory and applications; biological macromolecules, properties and methods of measuring transitions from native to denatured state; macromolecular separation procedures, including ion exchange and gel filtration separations. Laboratory Experiments: Enzymic and chemical hydrolysis of p-nitrophenyl-acetate (one period); enzyme kinetics, pyridine nucleotide linked enzyme (one period); Geiger-Muller plateau determination and enzymic phosphorolysis of starch using p^{32} orthophosphate (two periods); molecular sizing (gel filtration) using I^{131} iodinated ovalbumin (one period); viscosity, helix coil transition with DNA (one period); N-terminal amino acid determination (two periods); ion exchange separation of classes of amino acids (two periods).

Equipment for Chemistry 6ABC will be expensive; therefore a maximum of 48 students are scheduled for each laboratory. We hope to provide: one pH meter for each student, one Spectronic-20 for every two students, one gas chromatograph (bread board variety) for every two students, one radio-counting apparatus for every two students, one kit of standard taper glassware for each student. Special films are being developed for NMR, infrared and mass spectrometry, and in addition we will provide copies of original spectra.

UPPER DIVISION COURSES

Starting with the third year, the courses are designed for chemistry majors. Each student is required to take three quarter-courses of physical chemistry lecture (Chemistry 113ABC), one quarter of physical chemistry laboratory (Chemistry 114) two quarters of intermediate organic chemistry (lecture and laboratory, Chemistry 113AB), and three additional courses, one of which must be laboratory oriented, and one selected from the group; inorganic, analytical, or biochemistry. The third required course can be selected from any area, and could involve advanced or qualitative organic, advanced physical, or further courses in analytical, inorganic or biochemistry.

Required for Graduation

Of the 45 courses required for graduation, chemistry majors will be required to take 15 in chemistry, four in physics, five in math, four in languages, two in English, ten as a breadth requirement taken from the humanities, social and life sciences, and the arts, and five elective courses.

TRANSFER OF CREDITS

It is unrealistic to epxect the courses at one institution to match those at another. Even if we taught from standardized outlines, differences among instructors, equipment, size of classes, scholastic ability of the students, and a host of other factors would result in wide variations. For the forseeable future, we have the added complication of

changing semester hours to quarter courses. The details of a conversion formula will no doubt be worked out by the Registrars. The number of credits received upon transfer is always a sensitive matter, but even more important is the proper place to enter the new curriculum. Our own students face these same problems during the change-over period and will be advised according to the following pattern:

Courses Completed Old System	Equivalent Courses New System	Enter Course	Notes
1A	1A	1B	1
1AB	1ABC	4ABC, 6ABC	2
5A	6B	4ABC, 6AC	1
5AB	6AB	4ABC, 6C	3
8	4AB	4C, 6ABC	
9	6A	4ABC, 6BC	
5A, 8, 9	4AB, 6AB	4C, 6C	4

Notes:

1. Requires some repetition of course work and is not recommended.
2. Students transferring with one year of traditional freshman general chemistry will miss some quantitative analysis. The new 6B will contain a few precise titrations.
3. The old 5B has no equivalent new course. Students who take a full year of quantitative analysis elsewhere will receive credit as an elective.
4. Students with 5A, 8 and 9 will normally enter the upper division with full credit, although they will be held for the 4C, 6C requirement for a chemistry major.

All students (our own as well as transfers) are urged to complete full year sequences under one system. Members of the chemistry faculty advise all our chemistry majors and will help transfer students choose the most appropriate course(s) at which to begin. Although our new curriculum may appear unconventional, in some ways it is more flexible than the old. With the splitting of the second year into six half-courses, there are many more places to enter the curriculum. The transfer student has most often taken 5A, 8 and 9 at a junior college and he will no longer have the problem of taking the old 112A and losing credit or taking 112B without the proper background.

As soon as we can do so, we will prepare general outlines of the material covered in our lower division courses. We expect to circulate these outlines to chemistry instructors throughout California. In this way we hope that students who intend to transfer to UCLA will be advised before they come of any topics which were not covered in equivalent courses at their old institution. We wish to emphasize that our outlines are not meant to influence any instructor, but only to provide a service to prospective transfers. It is our firm conviction that the topics covered in a course are not nearly as important as the way the course is taught. If the student is forced to think about the material and can handle exams which require more than just repeating what he has been specifically taught, then he will be able to learn any missing topics on his own. It is difficult to judge what was really required of the student from only the detailed course outline and sample examinations.

For the most part, junior college transfer students have held their own after coming to UCLA in recent years. At graduation, it is difficult to distinguish transfer from our own native students. Honors are received equally among the two groups, and both go on to graduate schools. The tables in the Appendix show a difference in chemistry grade point averages between the two groups, but it is a remarkably small difference.

SUMMARY

The new curriculum has been generated during long and vigorous discussions by most of our staff. It reflects a compromise among many views, and hence is evolutionary, not revolutionary. It is still experimental and subject to change. New blends of analytical, organic and biochemistry are being attempted, which we hope will serve not only our majors but also those disciplines which we service. We hope to close the gap, at least partially, between laboratory practice taught to freshmen and sophomores and laboratory practice in research and development laboratories. There is no doubt that a tremendous amount of material will be presented more efficiently and, we hope, more effectively. Perhaps most importantly, we hope that our fresh approach will inspire our staff and students to reach a little above themselves.

APPENDIX

I. Number Transferring from Junior College to UCLA

	1962	1963	1964
February		5	8
September	21	30	23
Total	21	35	31

II. Number of Chemistry majors Graduating

	1962	1963	1964	1965
J. C. Transfers	18	21	23	16
All UCLA	33	33	19	35
Total	51	54	42	51

III. Grade Point Averages at Graduation (A=4.00)

	1962	1963	1964
J. C. Transfers (overall)	2.48	2.59	2.76
All UCLA (overall)	2.69	2.74	2.83
J. C. Transfers (Chemistry only)	2.56	2.55	2.77
All UCLA (Chemistry only)	2.76	2.80	2.89

NORMAL COURSE SEQUENCE FOR THE CHEMISTRY MAJOR

Quarter	1	2	3	4	5	6
Chemistry	1A	1B	1C	4A 6A	4B 6B	4C 6C
Math	11A	11B	11C	12A or 13A	12B or 13B	12C* or 13C*
Physics	1A	1B	1C	1D		
German		1	2	3	4* or	
Electives	English 1A				XX	XX

*Optional, but recommended for those going on to graduate school.
German and the electives may be interchanged.

Quarter	7	8	9	10	11	12
Chemistry	113A 133A	113B 133B	113C 114	X or 114	X	X

Critique of R. L. Pecsok's paper

THE NEW CHEMISTRY CURRICULUM AT UCLA

AND ITS RELATION TO THE JUNIOR COLLEGE STUDENT

by

Milton Tamres

The UCLA program typifies the many changes in curricula which are taking place at colleges and universities throughout the country. It was not the purpose of this meeting to discuss the merits of this particular change, some of whose features seem interesting, but rather to focus on how this change affects the transfer student and how it relates to the general problem of university-junior college articulation. In the brief outline which follows, the salient general questions raised and comments made will be summarized.

1. Are changes in state college and university curricula made in consultation with junior colleges?

   The apparent answer to this is NO! There appears to be a hesitancy to invite junior college staff to discuss the changes for fear this might be misconstrued as a form of coercion to follow suit. Presumably, an understanding exists that no change is finalized for at least a two-year period, to allow for the announcement of change and for adjustment to it. However, this is not always adhered to, and sometimes communication is slow.

2. What means of communication exist to report curricula changes?

   No formal mechanism exists to communicate these changes, at least not on a departmental basis. Where close liaison exists between certain junior colleges and the university faculty (e.g., junior college staff members teach at the university in the summer session), news of the changes is learned rather quickly.

   Articulation conferences are held somewhat irregularly and are attended predominantly by administrators. (In engineering and mathematics, there has been more effort than in chemistry to meet on a departmental level). The conferences are usually regional. The junior colleges in southern California are more likely to be familiar with the curriculum at UCLA, and those in northern California with the curriculum at Berkeley. Regional influence also grows from the fact that more Berkeley graduates join the faculties of junior colleges in the north, while UCLA graduates are more apt to stay in the south.

   The California Association of Chemistry Teachers performs some liaison functions, but these are not emphasized. As a scientific organization, it focuses more on bringing in high level research speakers and, in general, promoting knowledge in subject matter areas.

   Most universities (also true at Michigan) have an administrator whose function it is to visit the junior colleges and even interview prospective transfer students. His knowledge of departmental activity usually stems from the university course catalogue (which sometimes lags by a year the announcement of an adopted change in curriculum).

3. Is there a single course which junior colleges can follow?

   Junior colleges must train students who do not, as well as those who do, go on to upper level work. Consequently, they have at least two separate chemistry programs. But even for the students who are in transfer programs, more than one chemistry course may be offered (if the junior college is sufficiently large) to orient the students to more than one four-year school. Many junior colleges follow the Berkeley or UCLA program, if possible to do so, but others are oriented toward certain state colleges.

Courses set up by large departments generally are the result of compromise of many points of view. In the new UCLA curriculum, for example, there has been a consensus to introduce analytical and biochemical principles into the sophomore organic course; but, as some argue, part of the organic subject matter now may be too fragmented over several courses. With such different points of view prevalent, a course of the same number taught by different staff members of the department could be quite different. Even if a junior college were to try to follow the program of a selected institution, how would it know which "version" of the subject to teach? It seems that a strict following is not possible (or, perhaps, even desirable). The best that might be done is to impart a certain "philosophy" in handling the subject, leaving a certain latitude to the teacher to select the blocks and gaps for the course. Under these circumstances, it would be wise for an instructor teaching a course at the junior level, and presupposing certain background information, to present an outline of topics with which he expects the transfer student to be familiar.

In some cases, the university might adopt a curriculum which many junior colleges would find difficult to follow. For example, teaching thermodynamics in the sophomore year at Berkeley might make prospective transfer students from some of the junior colleges concentrate on getting other requirements out of the way in the first two years, e.g., social sciences, humanities and arts, leaving the science subjects to be taken at Berkeley. While such a transfer student still could finish in four years, presumably, he would be forced to do so with an extra heavy concentration of science and math courses.

4. Emerging importance of junior colleges.

In California by 1975 about 80 percent of college students in the lower division will be enrolled in junior colleges. Figures for other states are not as large, but the same trend is observed in the states of New York, Florida, Texas, Illinois and Michigan. In Michigan, for example, there were about 48,000 students in junior colleges in 1964, and 57,000 in 1965; an increase of nearly 19 percent in one year. It is estimated by the early 1970's that the figure for lower division students enrolled in junior colleges in Michigan will climb to 50 percent.

Even more impressive is the fact that about 40 percent of the chemistry majors at UCLA are transfer students, and the figure at Berkeley is above 50 percent. The large majority transferred from junior colleges rather than four-year colleges. These figures undoubtedly are much smaller in other states. At the University of Michigan, no separate statistics had been kept on transfer students in the past. Looking at the transcripts of our present crop of 172 junior and senior chemistry majors (including pre-meds), about 25 percent are transfer students, with a larger share coming from four-year schools (27 vs. 18).

That the junior colleges are doing a good job, by and large, of sending capable students on to the state colleges and universities is reflected in the small difference in grade point averages between transfer and non-transfer students. Part of the credit for the closeness in performance must lie in a suitable selecting or counseling system which places a student in a school where he has a reasonable chance to succeed.

National surveys (the Knoells-Medsker report) have shown that transfer students have more chance of success if they transfer in their junior year, rather than the sophomore year. No study has been made with regard to a single discipline. If applicable to all disciplines, however, it would suggest that potential chemistry majors be encouraged to finish a complete junior college program before transferring.

5. Some added comments.

With the growing college population, more states will be trying to formulate educational policies for their institutions of higher learning through their State Boards of Education. For many institutions, a period of adjustment may arise, as in the case of the California schools where the policy has been set for all schools to change to the quarter system. Unilateral action on the part of a single institution without regard for general policy could lead to complications. Equally troublesome would be decrees by State Boards which would drastically alter the long established character of an institution.

For effective interplay among the schools of higher learning, avenues of communication may profitably be explored. With the avalanche of students to come, and with the increasing acceleration of curriculum changes, rapid and effective communication may well be a necessity.

Finally, from the chemists' viewpoint, it should be considered that in ten years about half or more of all chemistry majors may be graduates of junior colleges. Surely, the instruction of chemistry in the junior colleges should be of concern to the entire chemical profession.

8.

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER AS SEEN FROM THE UNIVERSITY OF CALIFORNIA, RIVERSIDE

by

G. K. Helmkamp

Statistical Basis for the Problem

The origin of problems faced by the junior college transfer student is not only the act of transfer itself but also the special nature of the staff, curriculum and student body of the two-year institution. The problems themselves, though always important to the individuals involved, become of special concern to the four-year institutions when the transfer/native student ratio is significantly large.

In the California system of higher education the fraction of chemistry majors who are transfers from junior colleges is not only much too large to be ignored but it is planned to increase. Among the seniors receiving degrees in chemistry from the University of California at Riverside over the past five years, 52 percent were transfers from the state's junior college system. The pattern is not exceptional, for, as the data in the following table indicates, the graduating classes statewide are comprised of significant fractions of transfer students.

DISTRIBUTION OF CHEMISTRY MAJORS AT VARIOUS STATE CAMPUSES OF CALIFORNIA FROM 1960-1965

Campus	Total Majors	Number of J.C. transfers	Percentage of J.C. transfers
CSC Los Angeles	44	41	93
CSC San Diego	211	47	22
CSC San Jose	300	117	39*
UC Berkeley	--	--	53
UC Los Angeles	189	69	37**
UC Riverside	79	41	52
UC Santa Barbara	32	13	41

* An exceptionally large percentage (33) of transfers from other than junior colleges was reported.

** Includes data gathered from a four-year period only.

The quality of students who transfer (probably inseparable in concept from the quality of their preparation) is difficult to assess. As a qualitative observation on this campus, a large number of students who complete their education here were eligible for university enrollment at the time they entered junior colleges. It seems likely that some additional selectivity factor must have influenced decisions about initial matriculation.

On the basis of actual grade points, as shown in the following table, the transfer student performs about 0.1-0.2 unit behind the native student during the last two years of college.

PERFORMANCE OF NATIVE AND TRANSFER STUDENTS

	GPA, Native Students	GPA, Transfer Students
CSC Los Angeles		
Upper division chemistry	3.10	2.30
Overall upper division	3.31	2.48
CSC San Diego		
Upper division chemistry	2.71	2.48
Overall upper division	2.73	2.41
CSC San Jose		
Overall upper division*		
UC Los Angeles		
Upper division chemistry	2.82	2.63
Overall upper division	2.75	2.61
UC Riverside		
Upper division chemistry	2.93	2.81
Overall upper division	2.82	2.65
First two years	2.63	2.97
Total four years	2.73	2.81
UC Santa Barbara		
Overall upper division	2.70**	2.52
First two years	--	2.64

* Among transfer students in 1965, 75 percent of the seniors and 25 percent of the juniors have less than a 2.50 GPA.

** Average for all majors.

If there is indeed some selectivity factor involved in initial choice of school this discrepancy should be smaller yet. From very limited data, presently available only from UC Riverside and UC Santa Barbara, the junior college student who eventually transfers has better lower division grades than does the native student. Thus the native student improves his record from lower to upper division but the transfer student falls back.

It would be well to compare the performance of chemistry majors with that of all transfer students. The University has compiled data over three-year periods, the last of which was Fall, 1961 to and including Fall, 1963. It showed the following:

Number of entrants eligible for University admission directly from high school	3,899
Junior College GPA	2.92
First semester University of California GPA	2.38
Differential	-0.54
Number of entrants ineligible for University admission directly from high school	4,004
Junior College GPA	2.80
First Semester University of California	2.25
Differential	-0.55

For Fall, 1964, the available information is reported by campus.
For junior college students eligible directly from high school the record is as follows:

PERFORMANCE OF UC AND JC STUDENTS,
ELIGIBLE FOR UC DIRECTLY FROM HIGH SCHOOL

Campus	No. of Students	JC GPA	UC GPA	Differential
Berkeley	464	2.98	2.40	-0.58
Davis	170	2.86	2.39	-0.47
Los Angeles	434	2.92	2.35	-0.57
Riverside	95	3.02	2.43	-0.59
Santa Barbara	247	2.90	2.39	-0.51
TOTALS	1,410	2.94	2.39	-0.54

Some of the discrepancies were extreme. For example, two students had completed physics without any calculus; four had no language, mathematics or physics; and two others had an interrupted language sequence and no mathematics or physics. A completed mathematics program (through calculus) was most common (27 out of 41).

The junior college transfer student does in fact spend more time than the native student in acquiring a bachelor's degree. Among the most recent chemistry majors for whom complete records are available, the transfer student spent an average of 9.8 semesters versus 8.3 semesters for the native student. At the same time, he accumulated about the same number of units (128.5 versus 124.0). It is difficult to draw a firm conclusion about the cause of discrepancy because more than one indeterminate factor is involved. In many instances in which a long period of continuous enrollment is necessary for graduation, a student has found it necessary to take light loads to accomodate outside work for financial support. An exceptionally large fraction of these students attend junior colleges because of lower costs and the automatically developed geographical relationships between home, college, and place of employment.

The unusual pattern of time spent and units acquired is best given by tabulation of individual records. This is presented without further comment.

TIME-UNIT TABULATION FOR CHEMISTRY MAJORS AT UCR

TS	8	8	8	8	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9
	120	122	123	123	123	123	123	123	123	124	128	129	133	120	121	122	123	126	126
											132								
S	9	9	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	11
U	127	134	136	120	121	121	124	124	129	130	131	131	132	132	135	146	147	120	134
	131			126		139		138		139			140	152	148			127	
S	11	12	13	13	14	14	14	15											
U	153	123	143	152	120	122	125	146											
	183			154	138	146	132												
NS	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
U	120	120	120	120	120	120	121	121	121	121	121	122	122	122	123	123	123	124	124
S	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	10	10		
U	126	126	126	127	129	129	129	132	132	120	120	124	124	124	140	125	126		

Key:

T-Transfer Student

N-Native Student

S-Semesters in attendance before bachelor's degree.

U-Units applied toward graduation (120 required). Second figure of units is the total units taken, some of which are in excess of 70 that can be transferred from junior colleges.

The Nature of the Problems Related to Transfer Students

I. The Curriculum. The special problem faced by chemistry departments at both two-year and four-year institutions is the unfortunate vertical structuring of the chemistry curriculum. In many disciplines it is not unusual to see all but the introductory course of a major appear in the final two years, but in chemistry there seems to be little need, desirability, or motivation to vary from a sequential arrangement of courses. With such vertical structure, it is necessary for the junior college to provide both introductory and follow-up courses that are prerequisite to all other chemistry courses. The result is a many faceted, often traumatic, experience for all individuals and groups involved.

Because the Riverside chemistry department has as many transfer students as upper division native students, there has been a major restriction on experimentation with the chemistry curriculum. If modifications became too severe, we would effectively cut off the junior college as a source of majors. The individual junior college is not oriented **to** direct its graduates to a single four-year institution, and even if it were, it could not adapt curriculum changes rapidly enough to avoid a discontinuity in the development of the major sequence. The solution to the problem cannot and should not be found in coordination of the extensive state system, for the various chemistry departments have complete autonomy in the development of their own programs.

The answer also should not lie in slow change or, at least immediately, in using the junior college as the sole state-supported educational opportunity for the first two years.

The junior college instructor has the major problem of relating his courses to an extremely wide spectrum of student goals and abilities. In the usual situation it is doubtful that the serious chemistry major can find the proper courses, for he is competing in a program that attempts to provide simultaneous satisfaction as a service function. As a qualitative observation, the consequence is the need in many instances to recommend remedial work, particularly in organic chemistry and instrumental analysis (or the

equivalent of a second semester of quantitative analysis). At UCR, for example, we consider the situation exceptional if we do not expose a student to at least one course in analytical (i.e., instrumental, inorganic, organic and physical chemistry). This broad exposure represents an indirect way to carry out a remedial process and a direct way to evaluate the student for job or higher education opportunities. The process certainly is not the most efficient that might be devised. If the junior college program is to be given a significant role, as it presently enjoys in California, and especially if the role is to be expanded, it is necessary to establish the course sequences that should be delegated to it. For example, if the junior college is to give organic chemistry, it should uniformly provide both the year sequence and the one-semester course; or it should restrict itself only to the latter. The difficulty arises because of the non-uniformity. As a matter of fact, all sequence courses whether in the major or not should be completed at one institution. This is particularly important in mathematics, physics and the languages.

Organic chemistry represents a difficult problem. If a student takes a semester course in the field he is not exempted from any portion of the standard one-year sequence. It has been attempted; it invariably is disastrous. The short course does serve the function of easing the student through his transition problems because he is quite well prepared to compete with others who are having their first exposure to organic. If the transfer student has had a year sequence in his junior college program, we are faced with the dilemma of choosing between remedial work for all or instituting a placement examination. At CSC, Los Angeles, the same problem exists, for their "experience has demonstrated that the students must generally repeat courses (i.e., organic chemistry)." At present, fortunately, there is no problem of duplication of credit - the entire three-semester package will count towards graduation.

In quantitative analysis our courses are organized in such a way that the first semester involves a conventional approach and is not necessarily required for a chemistry major. The second semester, which is a required upper division course, is highly instrumented, requiring proficiency in mathematics and physics, and usually is taken concurrently with physical chemistry. The second semester of quantitative analysis taken in junior college does not serve the same function. In a sense it cannot, for comparable facilities are not available and the student is not prepared for the rigorous approach. As is the case with organic chemistry there is no duplication of credit, but it would be more fitting for the student to extend or complete mathematics or physics sequences.

II. <u>The Student</u>. The question of whether a change of institutions represents a painful experience requires an indirect answer. For some students the change is traumatic; for others there seems to be no effect at all. In reference to grade patterns, there is no firm evidence that the student encounters serious difficulty. At Riverside the native student increases his grade point average slightly in the senior year compared with that in the junior year (from 2.72 to 2.92). The transfer student improves to about the same extent (from 2.57 to 2.73). If then the assumption is made that the transfer represents a difficult change, the student must be making a compensation through increased personal effort.

As suggested in previous statements, a principal problem of the student is that of interrupting a subject matter sequence by transferring to another institution. The situation is not unique for the junior college transfer, for almost every transfer student faces it to some extent. At UCR a recurring problem (described previously) is the organic chemistry into the year sequence; he must begin again. In this sense our native students are treated the same as the transfer students.

A more serious problem is the matter of college or departmental requirements. Language, physics, and mathematics sequences are developed with a wide variety of emphases and patterns, and it is always difficult and sometimes impossible for a student to adapt to a new approach. It is essential that serious attempts be made in the junior colleges to adopt an all-or-none principle for course sequences, particularly when a student has a reasonably good idea about the school to which he will transfer.

If a student has had adequate exposure to mathematics, physics, and at least one year of chemistry he can fit easily into our normal program. However, we get a significant number of students who have not completed or have not had adequate preparation in mathematics and physics. The program then becomes very restricted, for physical chemistry must be deferred and all advanced courses are eliminated. If the student had not completed his language sequence (again not an unusual situation) and has deficiencies in science prerequisite courses, he will be faced with a five-year program.

Of the 41 junior college chemistry major transfers at UCR during the past five years only three have entered with mathematics and language requirements completely satisfied. Eight others had not started the language sequence (a standard pattern for native students). In general we consider the language no problem if the sequence is not interrupted. All the rest of the students had one or more problems, as shown in the following tabulation:

Students with an interrupted language sequence	4
Students with an interrupted physics sequence	5
Students with an interrupted mathematics sequence	3
Students with two interrupted sequences	13
Students with three interrupted sequences	5

III. The Instructor. Any educational institution suffers from the effects of bad teaching, but the junior college faces a unique origin of poor quality that is not (more precisely, should not be) associated with four-year, state-supported educational institutions in California. The junior college chemistry teacher has little opportunity to maintain competence in his field through first hand exposure to modern developments. His teaching loads are heavy and varied and he has too little sabbatical opportunity to take advantage of special programs. The poor teaching aspect, *per se*, is not of immediate concern; the lack of competence in subject matter should demand immediate attention. It is not necessary that all instructors in chemistry become involved in research; but it seems inevitable in a rapidly moving field that they maintain some contact with current problems.

Teacher competence is the crux of maintaining the expanding relationship between two-year and four-year institutions. If a cooperative venture is to remain meaningful, provision must be made to allow the junior college faculty member to extend his experience of special contact with colleges and universities. Initiation of such a program is the one recently supported by the National Science Foundation for summer work at Riverside. The objectives, as stated in the original request are:

> "---to aid junior college faculty members to offer better instruction in chemistry. A more specific objective of this Institute is to update the knowledge of the teacher in areas where advances are occurring rapidly (for example, structure of molecules, mechanisms, instrumentation, energetics and kinetics, photochemistry), and where the knowledge from a college course of ten or twenty years ago is no longer sufficient for the junior college teacher to give an adequate course. A second specific objective is to offer a laboratory in which the teacher may use modern instruments, carry out experiments designed to give him some understanding of certain modern concepts and how they are derived, and help him design experiments which he can use in his own classroom. The third objective of this Institute is to present a group of findings from research frontiers with the hope that the participants will be able to incorporate some of them in their courses; the need to bring undergraduate students closer to the excitement of the actual scientific discovery during his crucial formative years is well recognized."

It is not implied in any of the previous statements that all junior college instructors are lacking in competence in their field. It should be stated explicitly, however, that there are too many in that category for one to feel that the junior college system is now prepared to undertake the initial education of all potential chemistry majors.

IV. General Conclusions. Our primary concern must be with the unnecessary problems that the transfer student faces. There is a need to strive for more uniformity in the junior colleges in these areas:

1. Curricula designed for the chemistry major.
2. Curricula that provide for completion of sequences in languages, mathematics, physics, and organic chemistry.
3. The development of procedures to allow the junior college instructor to maintain or expand his competence in chemistry.

Many junior college chemistry majors are receiving an excellent background in and outside their fields of specialization. Qualitatively, they are being directed well to higher institutions, for their actual performance is not too different from that of the native student in the last two years. From subjective observations, they work harder on the average than native students, and the net results in terms of educational accomplishments are comparable. With limited data, we might even champion the cause that they turn out better, for of seven of our undergraduates in the past five years who have ended up as college or university faculty members, five have been junior college transfers.

Acknowledgement. I wish to express my gratitude to the following persons who provided me with statistical and other data on transfer students:

Stanley H. Pine, CSC Los Angeles; R. W. Isensee, CSC San Diego; Bert M. Morris, CSC San Jose; Richard E. Powell, UC Berkeley; Thomas L. Jacobs, UC Los Angeles; Harry W. Johnson, Jr., and James M. Greenfield, Jr. UC Riverside; and Bruce F. Rickborn, UC Santa Barbara.

In these days of computerized operations we found that no computers were programmed to furnish information related specifically to transfer chemistry majors. Consequently, and belatedly, I wish also to express my sympathy to the same group of people. The accumulation of data leading to an average GPA for a select group in a specific major over a period of years is a formidable task.

Critique of G. K. Helmkamp's paper

PROBLEMS OF THE JUNIOR COLLEGE TRANSFER

AS SEEN FROM THE UNIVERSITY OF CALIFORNIA, RIVERSIDE

by

Kent E. Backart

For simplicity, I have divided this critique into two sections - one devoted to the statistical portion of the report, and the second a more general review. Recommendations for each of the sections are included.

Statistical Report

The information presented was very lucid and enlightening and has definitely established that a problem exists. The most startling statistic from my point of view is the negative differential that exists between the GPA of the junior college student and his GPA during the first semester after transfer to the four-year institution. If the cause for such a differential could be established, corrective measures would be established with reasonable ease. However, I feel that before the cause can be established, more information must be acquired. Specifically, such information should go beyond the first semester after transfer, and include the second, third and fourth semesters. The possibility of trauma in transfer is not to be ignored, nor is the social adjustment of the student. Parallel investigations of the native student during his first few semesters at the four-year institution with those of the junior college transfer might be more enlightening than just the first semester after transfer. This might be a possible future project for a committee of the Advisory Council on College Chemistry: to investigate and develop a form which would amass the greatest potentially useful information and still be simple enough that it would not create undue work for secretarial staffs.

If such a form could be developed to improve the statistical picture, I would strongly urge that four-year institutions not only supply the two-year transferring institution with the information gained but also make certain that the chemistry department be apprised of the findings.

General Report

I was impressed with the general outlook Dr. Helmkamp had about the junior college program, yet in some instances I feel as if he (and others) are not completely informed. For example, the junior college instructor in chemistry is very well prepared not only in the basics, but also in the current developments of the more common fields of chemistry. The junior college instructor does continue his education by pursuing courses during the summer, and in many instances during the evening of the regular school year. Today, the junior college chemistry instructor without substantial work beyond his M.S. in chemistry is very rare. As to the overload that was mentioned - this cannot be resolved without financial or legislative assistance.

Secondly, the equipment is quite good at the two-year school. The notable exceptions here are the very small rural junior colleges such as those at Blythe, Reedley, Shasta, etc. Some casual observations indicate that the freshman and sophomore students probably get more chance to use some of the less sophisticated apparatus in the junior college than do their counterparts in the large state colleges and university campuses. Such equipment as pH meters, single pan balances, spectrophotometers are commonly used in many of the freshman courses at the junior college level.

I would completely agree with one statement that was made - a sequence course should not be split between two institutions. Although this is probably least important during the general chemistry course, it is still a problem since the coverage will vary both with respect to content and organization. Other courses such as organic must not be split. I would even recommend sending a directive to all counselors to advise the student that transfer credit

would not be given for a two-semester sequential course if the work is divided between two institutions. If all of the two- and four-year colleges adopted this philosophy, many students would benefit.

Further discussion of the report leads me to recommend (or possibly reiterate) the following points:

(a) Four-year institutions should invite representatives from the two-year colleges to attend meetings in which extensive discussion of radical changes are being considered for future curricula. General meetings between the two schools should be held at least twice a year merely to establish rapport, and to allow each to become more familiar with the others' problems.

(b) Brief summaries should be submitted to the two-year colleges by the four-year institutions with respect to lower division courses. Such summaries would indicate texts used, approximate coverage and major emphasis. In no way would this be considered a course outline.

In summary - when better communication and articulation are in effect - the major problems of transfer will be solved.

9.

THE PROBLEMS OF A JUNIOR COLLEGE HAVING TWO CHEMISTRY PROGRAMS

by

Fred C. Dietz

Merritt College, Oakland, California was established in 1954 as a junior college with a strong liberal arts program. In 1962, a Chemical Technology Program was started and thus we became a junior college with two chemistry programs. Our problems are those that come from having an established chemistry program at the college level and then adding a chemical technology program.

The philosophy that was back of the establishment of the Chemical Technology Program at Merritt College was that a community college should establish curricula that will help prepare its students for useful lives. Since a large number of the students at Merritt College have little hope for success in the four-year programs offered by neighboring institutions*, our aim was to develop two-year programs that would serve this class of students. The development of a two-year Chemical Technology Program fits in with this aim.

A brief account of the development of our Chemical Technology Program may be of interest. The first step was to establish a need for chemical technologists. Interviews with employers of chemical technologists in our community were conducted during 1958 and 1959 showing that a large number (more than 100) technicians were hired every year by local industry. Only employers that were closer to our college than to any other junior college in the Bay area were considered in these interviews.

The results of these interviews showed that each employer had quite different ideas of the qualifications that should be required of a chemical technician. The overall range of qualifications was so wide that it was clearly impossible to set up a curriculum that would produce a technician trained to please more than a few of the potential employers. Our approach was to steer a middle course. We decided that we would set up a training program to prepare our graduates so well that they would be readily acceptable to most employers. We planned to revise our curriculum as a result of interviews with our employed students and their employers, and thus improve our program as we went along.

Another way in which we got a great deal of help in starting our Chemical Technology Program was to select an advisory group from local industry. We asked each of the five largest employers of chemical technologists in our area to appoint a person to our advisory board. Nearly all employers sent senior technical men as their appointees to our board. At least once each semester this board meets with our chemical technology staff to discuss problems or to observe the performance of our students. Establishment of an advisory board is indispensable to a satisfactory program, in our opinion.

Merritt College has been willing to support development of a Chemical Technology Program. Perhaps $15,000 with matching funds from the National Science Foundations, for the purchase of instruments and special supplies; enough teacher time for the complete program; at least one laboratory and one lecture room devoted wholly to the Chemical Technology Program are the minimum requirements -- and these the college has furnished.

If a college is sure that it has (1) a pool of potential students, (2) a group of sympathetic teachers, (3) an area in which there is a continuing need for chemical technicians, and (4) an administration that is willing to support this program (with money, teachers, space, and the patience necessary for the initiation and growth of the program), the school can then start its own program.

*The University of California, Berkeley; San Jose State College, California State College at Hayward, and San Francisco State College.

Setting up a curriculum was not difficult for us. We patterned our curriculum on existing programs. In 1960, we wrote to about 20 colleges throughout the United States that had active, successful chemical technology programs. We asked for their course pattern in chemical technology and also for a course outline for each of their required courses. From a compilation of this inquiry we developed our own curricula, revising and compromising as we went along.

After we had completed the design of our own program, we asked our local advisory board to approve. They suggested some modifications. Our board had strong feelings on some points. Especially controversial was the advisability of having a course in qualitative analysis. Eventually, a curriculum generally satisfactory to our advisory board was agreed upon.

We found that local chemical employers would not guarantee to hire our graduates, though they were thoroughly conversant with our program and approved it in every detail. It is unreasonable, and we think undesirable, to expect industry to agree in advance to hire graduates of the program. Our experience has been that finding employment for graduates of our Chemical Technology Program has never been a problem.

The staffing of a chemical technology program in junior colleges is a serious problem. We have observed that the programs which failed were usually run primarily by one person, and were often regarded as the special project of that individual. Merritt College at present involves five different instructors in its Chemical Technology Program. This is half of our full-time staff.* With this method of staffing, students are exposed to five different teachers and each one gives the program his own personal touch. The staff, in turn, has differing opinions on each student, and each staff member can help in evaluating the capabilities and directing the work of every student. A close liaison between teachers in the program is very important if each student is to be helped to the point where he can develop the skill required of a good chemical technologist.

In most large junior college chemistry staffs there is some member who is unsympathetic to a Chemical Technology Program. On our staff, we have one member who is quite unsympathetic to the program. We do not ask him to teach in the program but we observe that even he is showing a little interest in the program now.

We have found that the most difficult problem in establishing a Chemical Technology Program is finding proper candidates for the program. The Chemical Technology Program gets students from many sources. Primarily, they (1) come from pre-tech programs in high schools, (2) are referred by counselors, and (3) come into the program by lateral transfer from college level programs. A pre-tech program in engineering in two of our high schools has been very successful in recruiting students for that program. However, since no pre-tech program in chemical technology has been established we have no experience with students from this source. Referrals by counselors have not been very successful, since counselors continually forget the existence of our small specialized program. Regularly spaced letters of reminder to the counselors are essential, if the program is to continue to get new applicants from this source. The lateral transfer of students from college level chemistry programs has been our best source of candidates for the program. This source too has special problems, particularly when teachers or counselors forget to suggest the Chemical Technology Program as an alternate to failure in the college level chemistry course.

The student who has a reasonable chance for success as a chemical technologist must have a definite determination to succeed in this field. He must enjoy laboratory work. He must also have enough facility with numbers to make stoichiometric calculations, read graphs, and operate a slide rule and a key punch calculator. He must be capable of

*Only 1 1/2 full-time teaching positions are used in our Chemical Technology Program.

following written and oral instructions. He must be sufficiently verbal to be able to write a description of the work that he has carried out. Our task is to find students who can meet these qualifications. However, students who clearly have the ability and determination to succeed in a program leading to an A.B. or a higher degree in chemistry are not encouraged to enter our Chemical Technology Program.

In each large metropolitan area, it is reasonable that a Chemical Technology Program soon will be or already is established. Before a second program is started in the same area, consultations between the neighboring institutions should be established, so that the second institution to establish a Chemical Technology Program may profit from the experience of the first institution.

Merritt College started its Chemical Technology Program in 1962 with about 20 students in its first class. Two years later, three students from this group graduated. The following year we had seven graduates and this June we will graduate nine students.

We are disappointed that the number of candidates for this program has not increased. We feel that as an experimental program our Chemical Technology Program deserves to be continued. Our outstanding problem is recruitment of students. Unfortunately, the status of the technician in the United States is not very high. The public neither understands nor admires the many supporting activities that are necessary for success in any scientific endeavor.

Even the press tends to sneer at some "technician" who failed to remove a protective cap over a fuel line, thus causing the failure of a rocket shot. Until the status of the technician is improved in the public eye, recruitment of students into any technician program will be difficult.

Recently we have found it necessary to assign three hours per week of one teacher's time to publicizing our chemical technology program in our local high schools. This time is spent in visiting high schools, talking to high school teachers and counselors, and in bringing interested high school students to our school to show them our facilities in order to sell the program.

If technicians were exempted from the draft, I am sure that chemical technology programs would not lack for applicants.

The establishment of a Chemical Technology Program has some interesting advantages which accrue to the Chemistry Department. A greater interest in the practical phases of chemistry and in the local chemical industry has resulted. Consequently, a better relationship now exists between industry and the college. The acquisition of modern instruments for an instrumental course for technicians gives the department access to many instruments not usually available in junior colleges. In our case, a Perkin-Elmer 237B 1-R spectrometer, a Wilkins aerograph A90C, a Sargent 21 polarograph, a Malmsted-Enke Instrumentation Laboratory station, a Sargent Micro combustion apparatus, an Eberbach Electrogrametric analyzer, a photocell Densitometer, a Tektronix 503 Oscilloscope and a Baird Atomic 125 Scaler are among the instruments that were acquired for our Chemical Technology Program.

Is the development of a chemical technology program such as we have at Merritt College really worth the effort? I feel emphatically that it is. The justification is that students who could rarely expect to be included in the rank of scientists can, as a result of this program, participate in scientific efforts of our country. They can join the scientists' team.

We are thus developing additional manpower to help our scientific efforts. At Merritt College this manpower has been developed among those who are not in the most able group of students. They often come from culturally disadvantaged families and, as a consequence, need very sympathetic and patient instruction on an individual basis. Many of our chemical technology students at Merritt College are non-white.

By adding one or two courses to several existing chemistry courses, a chemical technology program can be put together with much less effort than we had expected. Such a composite program might even lead to the placement of many students as "Chemical Technicians."

But would these students be career oriented or would they always think of themselves as having just stopped to rest awhile near the bottom, labeled "technician," on the ladder to success?

This occasional or accidental or temporary technician is certainly not going to be as steady as the man who has worked hard and succeeded in achieving the status of technician. In many programs the failures are the ones who are pushed out as technicians. In our program only those who succeed become technicians.

Critique of F. C. Dietz's paper

THE PROBLEMS OF A JUNIOR COLLEGE HAVING TWO CHEMISTRY PROGRAMS

by

Robert D. Fellman

The community college is very much involved in the education of students enrolled in two-year career programs of a technical nature. The involvement is both in terms of numbers of students and budget. At Foothill College 30 percent of the student body is enrolled in terminal programs. The establishment of a terminal curriculum leading to the A.A. degree is determined by community needs as seen by the college curriculum committee and an advisory council representing both the college and professions. At the beginning of fall, 1965, 32 curricula at Foothill College were being implemented. A chemical technology curriculum is not among these, inasmuch as the need for the program has not been established in the peninsula area.

A tri-college (College of San Mateo, Foothill College, San Jose State College) study of employment and education of science and engineering technicians (published by the California State Department of Education, Sacramento, 1965) appraised the availability of technicians in 37 major vocational fields. Only two fields, chemistry and design, were assessed as having many technicians available. In the area surveyed, 352 technicians were working in the chemical field. One of the conclusions of the study was that over 50 percent of the companies secured technicans by upgrading their own personnel and preferred this method.

Merritt College, as reported by Fred Dietz, has had considerable difficulty in recruiting students for its Chemical Technology program. One possible reason given was the lack of status of the technician. If "status" is measured by salary and fancy employment titles, this lack does not seem to be necessarily real. It would also seem that this status would not be enhanced by encouraging chemistry dropouts to enroll in a general program of chemical technology. The implication that technicians or prospective technicians are much different in general ability from the prospective transfer students cannot be justified. Students from Foothill College have elected to accept jobs in the chemical industry having satisfactorily completed chemistry courses taken by transfer students such as premedical students. Marital and financial status as well as "situation," may determine whether the student elects to continue for a bachelor degree. At Foothill College, approximately the same percentage of "terminal students" and declared transfer students elect to continue at a four-year college.

A national survey conducted by the Manufacturing Chemists' Association in 1963 at the request of the President's Science Advisory Committee indicated that 80 percent of the respondents anticipated no difficulties in obtaining chemical technicians in the future but felt that some college training was preferred or mandatory. A "formal" two-year college-level course was preferred but not defined. The idea finally was proposed that the more education the individual had, the better chance he would have to get a job as a technician. The question arises then, "Should junior colleges set up two-year curricula specifically for chemical technicians?" The judgement has to be made on the basis of need and cost. For many junior colleges in the western part of the United States at least, the answer to the above question will probably be negative. This means that the junior colleges should provide the type of chemistry and related courses from which a future technician can profit and gain an opportunity for employment. Few students probably enroll in a junior college to "become" chemical technicians. Somewhere along the line this opportunity is presented; hence, "general education" can continue even though the A.A. degree is not obtained.

In areas where there is some demand for technicians, but not enough to justify a special curriculum, industry can play a significant role in the recruitment of personnel and the training of technicians.

(1) Industry should be willing to provide summer employment or part-time employment to prospective technicians.

(2) Training involving the operation of specialized equipment should be the responsibility of industry because of the cost involved.

(3) Chairmen of Chemistry Departments should be advised when prospective technicians are identified by industry or college placement services.

(4) A special project course in a junior college may well serve as an opportunity for specialized training (other than general chemistry, quantative analysis, and organic chemistry).

(5) Placement services at the junior college may act as liaison between the chemistry department and industry.

Some of our state colleges offer a Bachelor of Arts degree in chemistry which provides chemical training for those wishing to obtain work of a "broad technical nature" in laboratories or in fields allied to chemistry. One semester of calculus is required, as well as noncalculus physics. A student finishing a minimal chemistry and mathematics program at a junior college may easily transfer into such a program and have the opportunity to continue upper division work without completing the usual supporting courses for a physical science major (four semesters calculus, three semesters of physics (calculus), and foreign language). Such a curriculum fits in with "the more education the greater opportunity" philosophy of industry insofar as chemical technology is concerned.

The needs for chemical technicians and the desired qualifications for hiring vary so much in the chemical industry that it would seem that two years of lower division chemistry (with related courses) and three to six months of on-the-job training should provide the type of background generally desired by most employers. Only in areas where the demand is especially high can the cost of a special program and curriculum be justified.

10.

PROBLEMS OF THE 2-YEAR COLLEGE WITH A CAREER CURRICULUM

by

Fred W. Schmitz

Background and Curriculum

In many states, community colleges are probably the fastest-growing post high school educational institutions. This growth will no doubt accelerate in the next decade. In the area of chemistry education, many community colleges offer transfer programs and/or career technician programs. The transfer programs are designed to enable the student to pursue the first two years of the baccalaureate degree. Many of the career programs are designed to train technicians and grant the Associate in Applied Science degree upon successful completion of a two-year curriculum.

The State University of New York comprises all state-supported institutions of higher education with the exception of the four-year colleges of the City University of New York-City, Brooklyn, Hunter, and Queens Colleges. There are about 60 units in the University system: three University Centers, two Medical Centers, Graduate School of Public Affairs, 24 State Colleges and about 30 two-year Community Colleges. Eight community colleges in New York State offer two-year Chemical Technology or Chemical Engineering Technology curriculums leading to the Associate in Applied Science (AAS) degree.

In the State University of New York between 65 and 70 credits are required for the AAS degree, about 30 credits of which are general education--English, Social Studies, Mathematics and Physics. The remainder are technical courses, with the general pattern being as follows:

2 semesters	- General Chemistry and Qualitative Analysis	10 credits
2 semesters	- Organic Chemistry	10 credits
1 semester	- Quantitative Analysis and Instrumental Analysis	10 credits
	Technical options (Unit Operations, Industrial Chemistry, Laboratory Technology, others)	10 credits

Two of these colleges, Bronx Community College and the New York City Community College are in New York City.

Students - Admission, Attrition, Graduation

In the City University of New York applicants are processed through a central admissions office which allows six choices to any schools or curricular--four-year or two-year colleges. High school averages and Scholastic Achievement Tests are used in the selection of students. Each college and each curriculum has a quota. For the four-year colleges, the applicant can be reasonably sure of admission if he is in the top quarter of the entire body of graduates of all high schools, public and private, in New York City. Admission to the Liberal Arts and Science College at any of the City University units gives the student a wide choice of possible courses of study. Students who choose community colleges must select a specific curriculum, e.g., Electrical Technology, Medical Technology. At this point there is a problem that Chemical Technology faces in competition with other curricula and with Liberal Arts and Sciences. The unrealistic evaluation of abilities by students and their parents, combined with inadequate high school counseling and the lack of knowledge of the chemical technician's field, make for a scarcity of applicants at present. Important contributions could be made here by the American Chemical Society in curriculum recognition and status recognition in the Society for Chemical Technicians. Chemical industry could help by providing guidance and career literature to high school students.

Community college applicants, in general, come from the middle two quarters of the high school graduating classes. Admission generally requires a high school diploma with two or two and one-half years of mathematics needed.

Students admitted to the career programs in chemical technology are generally more poorly motivated, come from lower economic backgrounds and have poorer high school records and work-study habits than four-year college entrants. Thus, though the academic work is somewhat less difficult than in four-year college, the attrition rate is high. At the New York City Community College over the last ten years, records show that the average attrition is 35 percent at the end of the first semester, 20 percent after the second, and [illegible] percent after the third. About 35 percent graduate in two to three years.

Major causes of attrition are poor scholastic work and loss of interest in curriculum. (Which of these two comes first is often hard to tell.) One important function of the community college is to try to help the student make a vocational choice. Significant numbers of students transfer from one curriculum to another within the college. "Project Talent" indicates three out of four high school graduates change career plans after one year of college. Better articulation between two-year and four-year colleges could help to salvage some of the four-year college dropouts. More adequate counseling could direct some science-oriented students into chemical technology programs. A potentially very valuable program called "Operation Bridgehead" has been initiated under the direction of the New York State Education Department and the City University of New York. Operation Bridgehead is designed to increase the awareness of New York City high school students of the educational opportunities offered by the six community colleges of the City University. It is anticipated that, during the 1965-1966 academic year, academic and guidance personnel from the colleges will participate in the following activities which will be centrally coordinated through the Office of the Dean for Academic Development:

1) Preparation of the Community College Handbook, distributed to all community college counsellors, high school guidance counsellors, and community counseling agencies to serve as central reference to curriculums, admissions procedures, special programs, and work opportunities available at the colleges.

2) Dissemination of information to high school students through an audiovisual presentation and the distribution of a specially prepared brochure focusing attention on the opportunities offered by the community colleges.

3) Counseling in high schools by community college counsellors, with emphasis upon working with high school advisors to identify and counsel students, who, although academically qualified, may not be considering the possibility of continuing their formal education.

Large metropolitan areas or state university units may profit from any positive trends that may be forthcoming from this program.

Graduates of career programs in chemical technology either pursue further education full-time or enter the employment market, generally in the chemical or related industry. At the New York City Community College in the last ten years, records show that about 15-20 percent of the graduates of the chemical technology curriculum continued education full-time while about 80-85 percent took a job in industry. Of the latter, the great majority embarked on a program of part-time evening further education. Transfer credit to the four-year colleges varied according to graduate's achievement in the two-year career program and college transferred to. In general, transfer to some of the private four-year colleges in the Metropolitan New York area resulted in more credit for graduates than transfer to four-year colleges in the City University. Transfer to out-of-town colleges often results in very liberal credit from the New York City Community College. The range of credits transferred as reported by graduates ranges from ten to 65.

Nothing was indicated as to whether the further education was pursued full-time day or part-time evening. One problem cited by graduates who have had good academic records is that they need to take few chemistry courses and therefore they get rusty. Their time is spent on humanities, languages, and mathematics.

Staff - Faculty and Support Personnel

Our community colleges are primarily teaching institutions with few facilities available for research at the college. Students in career programs are occupationally oriented. The faculty should have a background in good industrial or professional chemical experience. Recruitment of personnel with the right combination of industrial background, professional preparation, and teaching ability and interest presents a problem for many colleges. In large metropolitan areas the problem is probably not as great as in many smaller communities where chemical technology programs exist or are being established. The faculty member who achieves the Ph.D. is often dissatisfied with the lack of research opportunities and is lured away by industry or the university. In the City University of New York as in many other systems, the four-year college salaries are higher than the community college salaries, in spite of equal academic qualifications. Two-year college faculty are also discriminated against in terms of workload, theirs generally being higher than that of the four-year college undergraduate faculty.

In the matter of support personnel, such as laboratory assistants, the two-year community college also faces problems. Recruitment of qualified personnel (with at least a two-year AAS degree) in areas competitive with four-year colleges or universities is difficult. Salaries are again lower than in the four-year colleges in spite of the fact that the duties and responsibilities are equal. In addition, as an added attraction, the four-year college often offers free tuition to a two-year degree graduate working toward a baccalaureate degree.

Critique of F. W. Schmitz's paper

PROBLEMS OF THE 2-YEAR COLLEGE WITH A CAREER CURRICULUM

by

E. S. Kuljian

This paper presented some of the problems currently experienced in the New York City Community Colleges and defined three areas:

1. Recruitment of students into the Chemical Technology program.
2. Follow-up education of the trainee.
3. Staff requirements to maintain a good training program.

While the New York Community Colleges are making an all-out effort in their locale to sell the chemical technology program, the program must be sold to the parents, for it is they who decide on Johnny's college education. Perhaps the ACS in its publication, "Careers in Chemistry," could advance the position of the chemical technician by explaining his role in chemical manufacturing as well as the great need for qualified technicians. The ACS might consider the merits of the two-track system of chemical education provided in England. This provides opportunity for further advancement for the non-university trainee by fulfilling requirements set by the Royal Society. Education of this character is conducted at the technical colleges. It is not unlikely that the two-year community colleges throughout the United States can assume this role. But, as pointed out, the program is quite expensive for the community college, for it does not have the upper division or graduate school to help justify the expenditure for instrummentation. Industry must assume some of the responsibility for this training. It can publicize its needs. It can engage in a cooperative program with the community college. Thus far the only criteria for training which have been suggested by the MCA are practically the same as that undertaken by the chemistry major. A less realistic program of study for the research assistant was proposed in the past by at least one member of the Committee on Professional Training. It must be recognized that the two-year college students, by and large, are students of limited ability. A relatively small percent will make the transfer grade, particularly in the science centered curricula. By making it easier for the student who successfully completes the two-year program to further his education through a work release arrangement with the colleges it would seem the program would be more attractive to the more able student by the mere fact that he would not be "stuck" at a particular level.

One of the major difficulties of the New York program, unlike the California program, is that students are further prevented from even attempting a chem tech program on the basis of previous achievement at the high school. The open door policy in California public junior colleges does afford the student a second opportunity. Complicating the New York situation even more is that students who might indicate interest in the chem tech program may not have had high school chemistry as an exploratory venture.

The problem of obtaining qualified staff and support personnel for stockroom supervision and laboratory assistance is a universal one faced by universities, colleges and particularly the two-year colleges. Some colleges have hired retired military service personnel or retired instructors on a part-time basis. Other institutions assign a member of staff to director of laboratories to oversee employees with limited training. It would seem that the chemical technician could also meet this shortage. The ACS constantly surveys salaries for graduate chemists with an eye toward establishing national norms. Such studies should be extended to include the chemical technician. There should be some attempt to equalize the salaries of the technician employed in the two-year college with his counterpart at the college or university in order to permit the two-year colleges an equal opportunity to employ competent support personnel.

Finally, the attitudes of the Society toward the junior colleges must change. The Society must accept the view that the junior college, in its own right, carries a role in chemical education equal to that of the four-year college.